1201

PHILIPS

Counter/Timer PM 6612

9446 066 120.1

Ordering number of this manual 9499 460 07802 760315/1/2

PHILIPS

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PHILIPS

80 MHz Counter/Timer PM 6612

9446 066 120.1

Instruction manual
Anleitung
Notice d'emploi et d'entretien

Ordering number of this manual
9499 460 07802

76 315/1/2

IMPORTANT

In correspondence concerning this instrument, please quote the type number and the serial number as given on the type plate on the rear of the instrument.

WICHTIG

Beim Schriftwechsel über dieses Gerät gebeten, die genaue Typenbezeichnung und Seriennummer anzugeben. Diese befinden sich auf dem Typenschild an der Rückseite des Gerätes.

IMPORTANT

Dans votre correspondance et dans vos réclamations se rapportant à cet appareil, veuillez TOUJOURS indiquer le n° de type et le n° de série que son marquées sur la plaquette de caractéristiques fixée sur la paroi arrière de l'appareil.

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I. INTRODUCTION

GENERAL INFORMATION

The PM 6612 can perform frequency, period, ratio, time/interval and totalize measurement.
The frequency range is 80 MHz and the resolution at time interval measurement is 100 ns.
Optional accessories such as four different oscillators, battery unit, BCD output unit and a D/A converter extends the field of application.

II. TECHNICAL DATA

Properties expressed in numerical values with statement of tolerances are guaranteed. Numerical values without tolerances are intended for information purposes only and indicate the properties of an average instrument. The numerical values hold good for the nominal mains voltage.

A. MEASUREMENTS

Frequency

Range	10 Hz—80 MHz
Gate times	100 ms, 1 s and 10 s, INPUT A The gate time is multiplied with a prescaling factor if input B is used.
Resolution	10 Hz, 1 Hz and 0.1 Hz
Accuracy	± 1 count ± time base error

Period average A

Range	100 ns—100 s
Frequency counted	10 MHz
Time resolution	100 ns
Accuracy	± 1 count ± trigger error* ± time base error

Multiple period A

Range	Sine wave: 10 Hz—10 MHz pulses: 1 Hz—10 MHz
Frequency counted	10 MHz
Number of averagings	$N = 10^2$ and 10^4
Time resolution	$\frac{100\ ns}{N}$
Accuracy	± 1 count ± trigger error/N* ± time base error

---

* Trigger error is $\leqq 3 \times 10^{-3}$ for signals with signal to noise ratio of ≧ 40 dB.

Time interval A—B

Range	100 ns—10^5 s
Frequency counted	10 MHz or 10 kHz
Time resolution	100 ns or 100 μs
Min. time stop to start	100 ns
Accuracy	± 1 count ± trigger error ** ± time base error

Count A

Range	1 to 999999999
Mode	Accumulates pulses during manual start — stop interval
Pulse pair resolution	12 ns

Frequency ratio A/B

Range	f_A : 10 Hz—80 MHz f_B : 10 Hz—10 MHz
Multiplier	N = 10^2 and 10^4 with correct decimal point positioning
Accuracy	± 1 count of f_A ± trigger error * of f_B/N

Check

10 MHz internally applied to channel A
Any measuring function may be selected

Auxiliary functions

Reset	Pushing "RESET" resets the counter. Releasing "RESET" starts new measurement
Start/Stop	In function "COUNT A" the gate time is manually controlled by push-button "START/STOP". The memory is automatically switched off.
Display time	Continuously variable 0.2—5 s and infinite if display time knob is pulled
Stand by	The switch is combined with display time control. Position "STAND BY" keeps an oven oscillator heated.
Memory	Switchable by push-button "MEMORY"

B. INPUT CHARACTERISTICS

Input A

Range	10 Hz—80 MHz full range, 10 Hz—100 kHz when low-pass filter is selected by push-button "< 100 kHz"
Sensitivity	Sine wave: 10 mV_{rms}, 6 dB down at 10 Hz pulses: 30 $mV_{p\text{-}p}$ for pulse width ≧ 6 ns and rise time ≦ 1 ms
Impedance	1 MΩ//25 pF
Coupling	AC
Attenuation	Continuously variable between 1×—20× in two ranges
Trigger mode (level)	Depending on signal duty factor: > 25%—< 75%: ~ (zero crossing) < 25%: ⎍ (on leading edge) > 75%: ⎍ (on leading edge)
Safe overload	
Attenuation ×1	max. 250 V DC or 230 V_{rms} ≦ 440 Hz > 440 Hz : falling to 12 V_{rms} at > 1 MHz
Attenuation ×20	max. 250 V DC or 230 V_{rms}

---

* Trigger error is ≦ 3×10^{-3} for signals with signal to noise ratio of ≧ 40 dB.

** Trigger error for any wave shape is ≤ $\pm \dfrac{2.5 \times 10^{-3}}{\text{signal slope (V/ns)}}$ ns

Input B

Range	10 Hz—10 MHz
Sensitivity	20 mV_{rms}
Impedance	1 MΩ//25 pF
Coupling	AC
Attenuation	×1, ×20 and continuously variable
Trigger mode (level)	Depending on signal duty factor: > 25%—< 75%: ∼ (zero crossing) < 25%: ⎍ (on leading edge) > 75%: ⎎ (on leading edge)
Safe overload	250 V DC or 230 V_{rms} ≤ 440 Hz > 440 Hz: falling to 12 V_{rms} at 1 MHz

Input C (rear)

Range	1 kHz—10 MHz
Sensitivity	500 mV_{rms}
Coupling	AC
Impedance	≈ 10 kΩ
Safe overload	50 V_{rms}

Ext. oscillator Via Input C.

C. OUTPUT CHARACTERISTICS

STD OUT

Output frequency	Internal oscillator frequency 10 MHz or external standard frequency 1 kHz —10 MHz
Signal level	Approx. 3 V_{p-p} (open circuit)
Output impedance	Approx. 200 Ω (short-circuit proof)
Coupling	DC

B OUT

Signal out	Normalized signal from input B
Signal level	Approx. 3 V_{p-p} (open circuit)
Output impedance	Approx. 220 Ω (short-circuit proof)
Coupling	DC

Display 9 digits
In-plane 7 segment gas discharge display with decimal-point indication

Gate lamp Indicates that main-gate is open and counting takes place. In stand-by position, the Gate lamp indicates that mains or battery voltage is connected

D. GENERAL CHARACTERISTICS

Oscillator See section Accessories, 2.1. and service manual

Supply

By mains	100—130 V or 200—260 V, 50 to 400 Hz, approx. 15 VA
By external battery	+11.8—+28 V, max 1 A—0.5 A at 12 V and 24 V respectively. 100 mA in STAND BY position if oven stabilized oscillator is mounted
Connector	4 mm banana connector
By internal battery option	PM 9673

Environmental characteristics

Temperature	
Storage	—40°C to +70°C —40°C to +50°C (With battery option PM 9673)
Operating	0°C to +50°C (0°C to +40°C with battery option PM 9673)
Mains interference:	Below CISPR
Altitude	Max. 90% RH (26°C dewpoint)
Storage	15000 m (50000 ft)
Operating	5000 m (15000 ft)
Humidity	Max. 90% RH (50°C)
Shock	Meets the requirements of the IEC68 Eb recommendations
Vibration	Meets the requirements of the IEC68F recommendations

Dimensions

Width	210 mm (8.25″)
Height	89 mm (3.5″)
Depth	325 mm (12.8″)

Weight Approx. 2.8 kg (6.2 lb)

III. ACCESSORIES

1. Standard accessories supplied with the instrument

1 mains cable
1 manual
1 1.6 A fuse ,fast action
1 "115 V" label

2. Accessories to be ordered separately

2.1. Oscillators
PM 9677 Standard oscillator
PM 9678 TCXO
PM 9679 Oven-enclosed oscillator 1×10^{-7}/month
PM 9690 Oven-enclosed oscillator 1.5×10^{-9}/24 h.

2.2. Output interface units
PM 9674 BCD output unit
PM 9675 D/A converter

2.3. Input interface accessories
PM 9351 Passive measuring probe 10 MΩ,/11 pF 220 MHz, attenuation 10×
PM 9353 FET probe, 1MΩ/3.5F, 220 MHz
PM 9584 Resistive mixing piece, 50 Ω, 3 BNC sockets
PM 9346 Active-probe power supply

2.4. Coaxial cables
PM 9074 50 Ω, BNC to BNC,length1 m
PM 9588 Set of 50 Ω cables, BNC to BNC:
5 cables, length 20.7 cm
4 cables, length 40.5 cm
3 cables, length 60.3 cm
3 cables, length 198.6 cm

2.5. Mains cable
PM 9011 3-core detachable mains cable

2.6. 19″-rack mount adapter
PM 9669/01 for one counter
PM 9669/02 for two counters

2.7. Battery unit
PM 9673 Internal battery unit

2.8. Carrying case
PM 9672 Carrying case for the instrument

IV. INSTALLATION

1. Mains voltage conversion

The instrument can be converted into two mains voltage ranges 100—130 V and 200—260 V. The frequency range is 50 to 400 Hz. At delivery the instrument is set to the 200 to 260 V range.
When changing to the 100 to 130 V range the connections of the mains transformer should be changed as shown in figure IV-1, and the label "230 V" covered with the "115 V" label supplied.

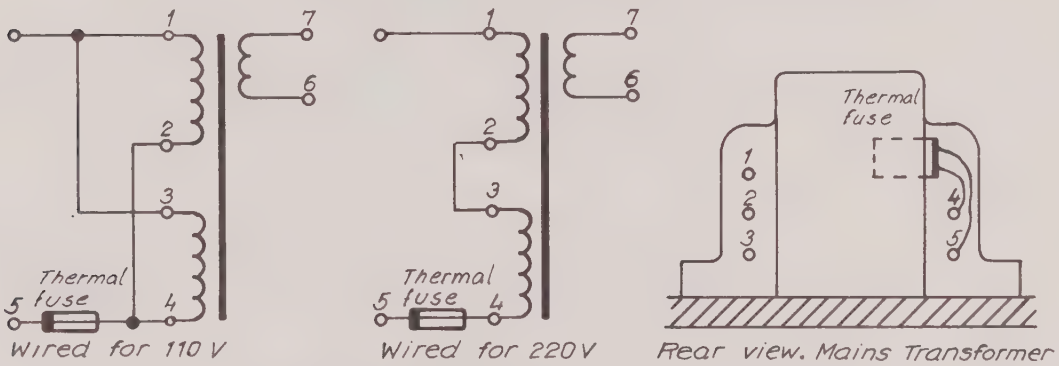

Figure IV-1. Mains transformer connections

2. Earthing

The local safety regulations prescribe how the instrument should be earthed. Two ways are possible:

1. Via the protective earth terminal at the rear panel.
2. Via the three core mains cable plugged into an outlet with protective earth contact.

NOTE: Use only **one** of these alternatives to avoid hum!

3. Fuses

A thermal fuse on the mains transformer and a 1.6 A fuse, fast action, on unit U1 are protecting the power supply. Figures VI-1 to VI-4 on pages 42 and 43.

4. Optional accessories

Refer to installation instruction given in manual for each type number.

V. CONTROLS, INDICATORS AND CONNECTORS

Refer to figures VI-1 to VI-4 on pages 42 and 43.

1 DISPLAY TIME

Sets display time between 0.2 and 5 s.
Infinite display time when knob is pulled.
With switch set to position STAND BY the counter is turned off except the oven oscillator.
WARNING: Primary voltage of power supply is on!

2 GATE

Lamp indicating that the main gate is open and that counting takes place. With DISPLAY TIME knob set to position STAND BY the GATE lamp is on permanently indicating that the oven oscillator is on.

3 SENSITIVITY

Sets input sensitivity for channels A and channel B (orange text). The A control has two ranges, 100 mV to about 2 V (pushed) and 10 mV to 200 mV (pulled). The B control has one range, 100 mV to 2 V.

4 ⊓

When measuring signals at input A or input B with duty factor > 0.75 this push-button must be depressed to obtain reliable triggering.

6 ⊓

When measuring signals at input A or input B with duty factor < 0.25 this push-button must be depressed to obtain reliable triggering.

7 ~

When measuring signals at input A or input B with duty factor 0.25—0.75 this push-button must be depressed to obtain reliable triggering.

7 10 CHECK

When depressed the instrument is set to self check mode.

8 B

Input B. Signal input for RATIO and TIME INTERVAL measurement.
Range: 10 Hz to 10 MHz.

9 A

Input A. Signal input for COUNT, FREQUENCY, PERIOD, RATIO and TIME INTERVAL measurement. Range: 10 Hz to 80 MHz.

10 < 100 kHz ~

Low-pass filter. When measuring noisy signals at input A with duty factor ≈ 0.5 and frequency < 100 kHz triggering is improved by depressing this push-button.

11 Function selector

RATIO A/B

Sets counter to measure ratio between signals applied to inputs A and B. $n = 10^2$ and $n = 10^4$ indicate the number of decimals displayed.

COUNT A

Sets counter to add the pulses at input A in the time interval between depressing and releasing the START/STOP push-button.

FREQUENCY A

Sets counter to measure frequency at input A.
kHz is a measuring unit related to the display read-out.
0.1 s, 1 s and 10 s are the gate times.

PERIOD A

Sets counter to measure period at input A.
μs is the measuring unit related to the display read-out. $n=1$, $n=10^2$ and $n=10^4$ indicates the number of periods being averaged.

TIME INTERVAL A—B

Sets counter to measure time interval A to B, with start signal at input A and stop signal at input B.

⑫ **MEMORY START/STOP**

In released position the measurement information is stored until next measurement cycle is completed.
Depressed button makes display follow decade counters continuously. In COUNT A mode, start/stop operation.

⑬ **RESET**

Resets decade counter and display to zero.

Rear panel

⑭

Mains input.

⑮ **INT.BATT.OFF MAINS/EXT,BATT.**

Turns the internal battery off.
The mains or the external battery is the power source for the instrument. Internal battery is charged when mains cable is connected.

⑮ **INT.BATT.ON**

Sets power supply to be fed from the internal battery. Turns the mains or the external battery off.

⑯ **INPUT C**

Input C. Signal input for external time base signal 1 kHz to 10 MHz.

⑰ **STD OUT**

Output for the internal or external oscillator signal.

⑱ **BCD**

Input connector for BCD unit.

⑲ ⏚

Chassis ground.

⑳ −

Minus-pole connection for external battery.

㉑ +

Plus-pole connection for external battery.

Internal switch and connector

㉒ **INT.STD/EXT.STD**

Sets counter to operate with either internal or external clock oscillator.

㉓

Connector for D/A converter and BCD unit.

㉔ **B OUT**

Provides normalised signal from B input amplifier.

VI. OPERATION

Figures VI-1 to VI-4 on pages 42 and 43.

General Information

1. Switch on power

1.1. Mains

Before connecting the counter to the mains check that the mains transformer is wired for the local mains voltage. Refer to chapter IV, INSTALLATION.
Set switch MAINS EXT.BATT./INT.BATT.ON to position MAINS EXT.BATT. ⓯.
Connect mains cable to the counter at ⓮.
Turn DISPLAY TIME control ❶ to ON. Check that GATE lamp ❷ and display are on, indicating that power is on.

1.2. External battery

Set switch MAINS EXT. BATTERY/INT. BATT. ON ⓯ to position MAINS EXT.BATTERY.
Connect the cables from the external battery to sockets EXT.BATT. 12—24 V "+" ㉑ and "—" ⓴.
Check that GATE lamp ❷ and display are on, indicating that power is on.

1.3. Internal battery PM 9673

Set switch MAINS EXT. BATTERY/INT. BATTERY ON ⓯ to position INT.BATTERY ON.
Check that GATE lamp ❷ and display lights indicating that power is on. Blinking display indicates low voltages. Refer to manual PM 9673 for charging instructions.

2. Warm up time

The warm up time from the moment of mains connection is less than 7 minutes to an oscillator error of less than 10^{-7} for instrument equipped with the oven-enclosed oscillators PM 9679 or PM 9690. Instruments equipped with the oscillators PM 9677 or PM 9678 (TCXO) are ready for use at the moment of mains connection. Normally the instrument is switched on from the STAND BY ❶ position. If so, no warm up time is needed, irrespective of which oscillator is employed.

3. External frequency standards

House standards or other frequency standards can be used instead of the internal 10 MHz oscillator. If a time resolution of 100 ns is required, 10 MHz must be used.

When using 1 MHz instead of 10 MHz the decimal point must be shifted one step to the left to interpret the display correctly. To set the counter to external standard the internal jumper SK 131 ㉓, or SK 22 ㉒ at the rear panel, must be set to position EXT.STD.
The standard frequency used is available at rear output STD OUT.

Measurements

4. CHECK

1. Depress the two CHECK push-buttons ❼ ❿
2. Set DISPLAY TIME ❶ to mid-position
3. Rotate switch ⓫ and read display value as follows:

Function	Read (±1 digit)
FREQ 0.1 s	10000.00
FREQ 1 s	10000.000
FREQ 10 s	10000.0000
PERIOD n = 1	0.1
PERIOD n = 10^2	0.100
PERIOD n = 10^4	0.10000

4. Set switch ⓫ to position COUNT A.
5. Depress START/STOP push-button ⓬ : the counter will start totalizing the input pulses and the display will follow the counting continuously until push-button START/STOP ⓬ is released again.

5. FREQ. A

1. Set DISPLAY TIME ❶ to mid position.
2. Set function selector ⓫ to any of the three frequency positions that corresponds to the desired resolution of the measurement.
3. Connect the signal to be measured to input A ❾.
4. Match the input of the counter to the frequency and dutyfactor of the signal to be measured by depressing any of push-buttons ❹ ❻ ❼ ❿.
5. Adjust SENSITIVITY control ❸ for stable display read-out.

6. PERIOD A

1. Set function switch ⓫ to any of the three PERIOD A positions depending on the desired number of periods to be measured.
2. Match the input of the counter to the frequency and dutyfactor of the signal to be measured by depressing any of the push-buttons ❹ ❻ ❼ ⓾.

7. RATIO A/B

7.1. Normal operation

1. Set function switch ⓫ to any of the two RATIO positions depending on the desired number of decimals of the display read-out.
2. Set DISPLAY TIME ❶ to mid position.
3. Connect the signal with the highest frequency to input A ❾.
4. Connect the signal with the lowest frequency to input B ❽ (max. 10 MHz).
5. Match the input of the counter to the frequency and duty factor of the signal to be measured by depressing any of the push-buttons ❹ ❻ ❼ ⓾.
6. Adjust SENSITIVITY control ❸ for stable display read-out.

7.2. Increased multiplier factors and RATIO B/A

(only possible in counters with output B OUT at the rear, serial number prefix SM 2..).

1. Set switch INT.STD/EXT.STD ㉒ to EXT.STD.
2. Connect B OUT ㉔ with INPUT C ⓰ to EXT.STD.
3. Connect the one signal (max. 80 MHz) to input A and the other signal (max. 10 MHz) to input B. Match the inputs of the counter to the signals.
4. Set the Function switch ⓫ to desired position as indicated in the table below.
   Notice that the decimal point is incorrectly displayed.

Setting	RATIO × multiplier	Number of decimals displayed	Number of decimals correct
FREQ A 0.1 s	$A/B \times 10^6$	2	6
1 s	$A/B \times 10^7$	3	7
10 s	$A/B \times 10^8$	4	8
PERIOD A n = 1	$B/A \times 1$	1	0
$n = 10^2$	$B/A \times 10^2$	3	2
$n = 10^4$	$B/A \times 10^4$	5	4

8. TOTALIZE (COUNT A)

1. Set function switch ⓫ to position COUNT A.
2. Connect the signal to be measured to input A ❾.
3. Match the input of the counter to the frequency and duty factor of the signal to be measured by depressing any of the push-buttons ❹ ❻ ❼ ⓾.
4. Set DISPLAY TIME ❶ to mid position.
5. Depress START/STOP push-button ⓬.
6. When depressing the START/STOP push-button ⓬ the counter will start totalizing the input pulses until push-button START/STOP ⓬ is released again. The display will show the number of pulses counted in the time interval between depressing and releasing the START/STOP push-button ⓬.

9. TIME INTERVAL A—B.

1. Set the function switch ⓫ to any of the two TIME INTERVAL positions depending on the desired resolution.
2. Connect the start signal to input A ❾ and the stop signal to input B ❽.
3. Set the DISPLAY TIME ❶ to mid-position.
4. Match the input of the counter to the frequency and duty-factor of the signal to be measured by depressing any of the push-buttons ❹ ❻ ❼ and ⓾.

Note. With push-button ⓾ depressed the signal at input A is delayed approximately 2 μs.

Gebrauchsanleitung

I. EINLEITUNG — ALLGEMEINES

Der PM 6612 ist ein Universalzähler mit einem Frequenzbereich bis 80 MHz.
Mit ihm können Frequenz, Periodendauer, Frequenzverhältnis und Zeitintervall gemessen und Ereignisse gezählt werden.
Die Zeitauflösung bei Zeitintervall-Messung beträgt 100 ns.
Wahlweises Zubehör wie vier verschiedene Oszillatoren, eine Batterieeinheit, ein BCD-Ausgang und ein D/A-Ausgang erweitern noch den Anwendungsbereich.

II. TECHNISCHE DATEN

In Zahlen mit Toleranzangabe ausgedrückte Eigenschaften werden vom Hersteller garantiert. Zahlen ohne Toleranzangabe sind nur zur Information und geben die Eigenschaften eines Durchschnittsgeräts an. Sämtliche Werte gelten nur bei Nenn-Netzspannung.

A. MESSARTEN

Frequenz

Bereich	10 Hz—80 MHz
Meßzeiten	100 ms, 1 s und 10 s, Eingang A
Auflösung	10 Hz, 1 Hz und 0,1 Hz
Fehler	± 1 Ziffer ± Zeitbasisfehler

Periodenmessung A

Bereich	100 ns—100 s
Zählfrequenz	10 MHz
Zeitauflösung	100 ns
Fehler	± 1 Ziffer ± Triggerfehler* ± Zeitbasisfehler

Periodenmittelwertmessung A

Bereich	Sinussignale: 10 Hz—10 MHz Impulse: 1 Hz—10 MHz
Zählfrequenz	10 MHz
Mittelwertbildung über N-Perioden	$N = 10^2$ und 10^4
Zeitauflösung	$\frac{100\text{ ns}}{N}$
Fehler	± 1 Ziffer ± Triggerfehler/N* ± Zeitbasisfehler

* Der Triggerfehler beträgt $\leq 3 \times 10^{-3}$ bei Signalen mit einem Signal/Rausch-Verhältnis von ≥ 40 dB.

Zeitintervall A—B

Bereich	100 ns—10^5 s
Frequenz	10 MHz oder 10 kHz
Zeitauflösung	100 ns oder 100 µs
Min. Zeit Stopp/Start	100 ns
Fehler	± 1 Ziffer ± 1 Triggerfehler** ± Zeitbasisfehler

Ereigniszählung A

Bereich	1 bis 999999999
Betriebsart	Summiert Impulse während manuell gesteuertem Start-Stopp-Intervall
Min. Abstand zweier Impulse	12 ns

Frequenzverhältnis A/B

Bereich	f_A: 10 Hz—80 MHz f_B: 10 Hz—10 MHz
Vervielfachungsfaktor	$N = 10^2$ und 10^4 mit automatischer Einstellung des Dezimalpunkts
Fehler	± 1 Ziffer von f_A ± Triggerfehler* von f_B/N
Eigenkontrolle	10 MHz, intern auf Kanal A Es kann jede Meßfunktion gewählt werden

Hilfsfunktionen

Rückstellung	Durch Drücken der Taste RESET wird der Zähler rückgestellt. Bei Lösen der Taste RESET beginnt eine neue Messung.
Start/Stopp	In Stellung COUNT A wird die Meßzeit manuell mit der Drucktaste START/STOP geregelt. Der Speicher wird automatisch abgeschaltet.
Anzeigedauer	Stufenlos von 0,2—5 s regelbar, bei herausgezogenem Drehknopf DISPLAY TIME unbegrenzt.
Oszillatorheizung	Kombiniert mit dem Drehknopf DISPLAY TIME. In der Stellung STAND BY wird nur der Oszillator geheizt.
Speicher	Schaltbar durch Wähltaste MEMORY

B. EINGANGSCHARAKTERISTIKA

Eingang A

Bereich	10 Hz—80 MHz Gesamtbereich, 10 Hz—100 kHz wenn durch die Drucktaste »<100 kHz« ein Tiefpassfilter verwendet wird.
Empfindlichkeit	Sinussignale: 10 mV_{eff}, 6 dB niedriger bei 10 Hz Impulse: 30 mV_{ss} bei einer Impulsbreite von ≦ 6 ns und einer Anstiegzeit von ≦ 1 ms
Impedanz	1 MΩ//25 pF
Kopplung	AC
Dämpfung	Einstellbar zwischen 1×—20×
Triggerung (Pegel)	Für Signale mit einem Tastverhältnis zwischen 25% und 75% : ∼ (Nulldurchgang) Für Signale mit einem Tastverhältnis < 25% : ⎍ (Impulsvorderflanke) Für Signale mit einem Tastverhältnis > 75% : ⎍ (Impulsvorderflanke)
Überlastungsschutz	
Dämpfung ×1	max. 250 V oder 230 V_{eff} ≦ 440 Hz > 440 Hz: fallend auf 12 V_{eff} bei > 1 MHz
Dämpfung ×20	max. 250 V oder 230 V_{eff}

---

* Der Triggerfehler beträgt $\leq 3 \times 10^{-3}$ bei Signalen mit einem Signal/Rausch-Verhältnis von ≥ 40 dB.

** Der Triggerfehler beliebiger Kurvenformen beträgt $\leq \frac{2{,}5 \times 10^{-3}}{\text{Flankensteilheit (V/ns)}}$ ns

Eingang B

Bereich	10 Hz—10 MHz
Empfindlichkeit	20 mV_{eff}
Impedanz	1 MΩ/25 pF
Kopplung	AC
Dämpfung	Einstellbar zwischen 1×—20×
Triggerung (Pegel)	Für Signale mit einem Tastverhältnis zwischen 25% und 75% : ∼ (Nulldurchgang) Für Signale mit einem Tastverhältnis < 25% : ⎍ (Impulsvorderflanke) Für Signale mit einem Tastverhältnis > 75% : ⎎ (Impulsvorderflanke)
Überbelastungsschutz	max. 250 V oder 230 V_{eff} ≤ 440 Hz > 440 Hz: fallend auf 12 V_{eff} bei 1 MHz

Eingang C (auf der Rückseite)

Bereich	1 kHz—10 MHz
Empfindlichkeit	500 mV_{eff}
Kopplung	AC
Impedanz	≈ 10 kΩ
Überlastungsschutz	50 V_{eff}
Externer Oszillator	Über Eingang C.

C. AUSGANGSCHARAKTERISTIKA

STD OUT

Ausgangsfrequenz	Frequenz des internen Oszillators (10 MHz) oder des äusseren Frequenz-Standards (1 kHz—10 MHz)
Signalpegel	≈ 3 V_{s-s} (Leerlauf)
Ausgangsimpedanz	≈ 200 Ω (kurzschlußsicher)
Kopplung	DC

B OUT

Ausgangssignal	Normalisiertes Signal vom Eingangsverstärker B
Signalpegel	≈ 3 V_{s-s} (Leerlauf)
Ausgangsimpedanz	≈ 220 Ω (kurzschlußsicher)
Kopplung	DC
Anzeige	9 Ziffern 7 Segment-Gasentladungs-Anzeige mit automatischem Dezimalpunkt.
Tor (GATE)	Zeigt an, daß das Haupttor offen ist und eine Zählung stattfindet. In der Stellung STAND BY zeigt die Torlampe an, daß das Gerät am Netz oder an der Batteriespannung liegt.

D. ALLGEMEINE CHARAKTERISTIKA

Oszillator	Siehe unter Abschnitt »Zubehör«, Punkt 2.1 und in der Bedienungsanleitung.

Stromversorgung

Netz	100—130 V oder 200—260 V bei 50—400 Hz, 15 VA
Äußere Batterie	+11.8—+28 V, max 1 A—0.5 A bei resp. 12 V—24 V. 100 mA für den Thermostaten (STAND BY)
Anschlusse	4 mm Bananenstecker
Wahlweise eingebaute Batterie	PM 9673

Umgebungsbedingungen

Temperaturbereich	
Lagerung	—40° C bis +70° C —40° C bis +50° C (mit eingebauter Batterie PM 9673)
Betrieb	0° C bis +50° C 0° C bis +40° C (mit eingebauter Batterie PM 9673)
Netzstörung	unter CISPR
Höhe	Lagerung: 15.000 m Betrieb: 5.000 m
Feuchtigkeit	Max. 90 % rel. (Taupunkt 26°)
Stoßsicherheit	Genügt den Anforderungen der IEC-Empfehlungen 68 Eb
Erschütterungssicherheit	Genügt den Anforderungen der IEC-Empfehlungen 68 F

Abmessungen

Breite	210 mm
Höhe	89 mm
Tiefe	325 mm
Gewicht	Ca. 2,8 kg

III. ZUBEHÖR

1. Mitgeliefertes Standardzubehör

1 Netzkabel
1 Bedienungsanleitung
1 flinke Sicherung, 1,6 A
1 Schild »115 V«

2. Zusätzlich lieferbares Zubehör

2.1. Oszillatoren
PM 9677 Standardoszillator
PM 9678 TCXO
PM 9679 Ofen-Oszillator
PM 9690 Hochstabiler Oszillator

2.2. Ausgangseinheiten
PM 9674 BCD-Ausgangseinheit
PM 9675 D/A-Ausgang

2.3. Tastköpfe
PM 9351 Passiver Tastkopf 10 MΩ/11 pF, 220 MHz, Dämpfung 10×
PM 9353 FET-Tastkopf 1 MΩ/3,5 F, 220 MHz
PM 9584 Widerstandmischglied
PM 9346 Stromversorgung f. aktiven Tastkopf

2.4. Koaxialkabel
PM 9074 50 Ω, BNC—BNC, Länge 1 m
PM 9588 Satz aus 50-Ω-Kabeln, BNC—BNC:
5 Kabel, Länge 20,7 cm
4 Kabel, Länge 40,5 cm
3 Kabel, Länge 60,3 cm
3 Kabel, Länge 198,6 cm

2.5. Netzkabel
PM 9011 abnehmbares 3-Leiter-Netzkabel

2.6. 19″ Zusatz für Montage auf Ständer
PM 9669/01 für einen Zähler
PM 9669/02 für zwei Zähler

2.7. Batterieeinheit
PM 9673 eingebaute Batterieeinheit

2.8. Tragtasche
PM 9672 Gerätetragttasche

IV. INSTALLATION

1. Netzanschluß

Die Geräte können an zwei Netzspannungsbereiche, 100—130 V und 200—260 V, angeschlossen werden. Der Frequenzbereich liegt zwischen 50 und 400 Hz. Bei Lieferung sind die Geräte auf den Spannungsbereich von 200—260 V eingestellt.

Soll das Gerät an 100—130 V angeschlossen werden, so sind die Anschlüsse des Netztrafos entspr. Abb. IV-1 zu vertauschen und das Schild »115 V« über das Schild »230 V« zu schieben.

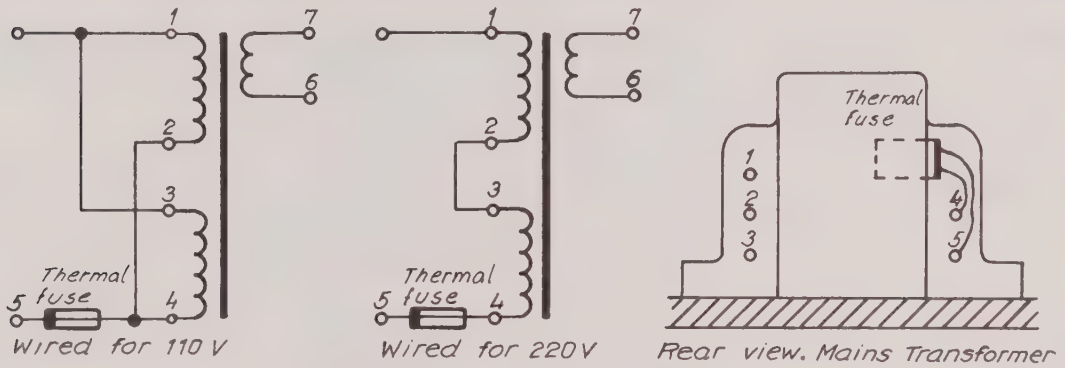

Abb. IV-1 Netztrafo-Anschlüsse

2. Erdung

Die Geräte sind den örtlichen Sicherheitsvorschriften entsprechend zu erden. Dies kann erfolgen über:

1. die Schutzerdungsklemme auf der Geräterückseite
2. das 3-Leiter-Netzkabel, dessen Netzstecker an eine Schukosteckdose anzuschließen ist.

ZUR BEACHTUNG: Doppelerdung ist zu vermeiden, damit keine Brummstörungen auftreten!

3. Sicherungen

Der Stromversorgungsteil ist durch eine thermische Sicherung am Netztrafo und eine flinke 1,6-A-Sicherung an der Einheit U1 abgesichert. Die abbildungen VI-1 zu VI-5 an den Seiten 42 und 43.

4. Wahlweises Zubehör

Näheres ist den Anweisungen in der Bedienungsanleitung des jeweiligen Zubehörs zu entnehmen.

V. BEDIENUNGSORGANE UND ANSCHLÜSSE

Die Abbildungen VI-1 zu VI-4 an den Seiten 42 und 43.

1 DISPLAY TIME

Einstellung der Anzeigedauer auf 0,2—5 s.
Unbegrenzte Anzeigedauer bei herausgezogenem Knopf. Steht der Schalter auf STAND BY, so ist der Zähler mit Ausnahme des Oszillator abgeschaltet.
ACHTUNG! Gerät liegt an Primärspannung des Stromversorgungsteils!

2 GATE

Leuchtet auf, wenn das Haupttor offen ist und eine Zählung stattfindet. Steht der Schalter DISPLAY TIME auf STAND BY, so zeigt diese Lampe an, daß der Oszillator ständig geheizt wird.

3 SENSITIVITY

Empfindlichkeitswähler für Eingänge A und B (orangefarbener Text). Der Eingang A hat zwei stufenlose Wählbereiche, 100 mV—ca. 2 V bei gedrücktem Schaltknopf und 10 mV—200 mV bei herausgezogenem Schaltknopf. Der Eingang B hat nur einen Bereich, von 100 mV—2 V.

4 ⊓

Bei Messen von Signalen mit einem Tastverhältnis von $> 0{,}75$ am Eingang A oder B ist diese Taste zu drücken, um eine verläßliche Triggerung zu gewährleisten.

6 ⊔

Bei Messen von Signalen mit einem Tastverhältnis von $> 0{,}25$ am Eingang A oder B ist diese Taste zu drücken, um eine verläßliche Triggerung zu gewährleisten.

7 ~

Bei Messen von Signalen mit einem Tastverhältnis von 0,25—0,75 am Eingang A oder B ist diese Taste zu drücken, um eine verläßliche Triggerung zu gewährleisten.

7 10 CHECK

Einstellung auf Eigenkontrolle.

8 B

Eingang B. Signaleingang für Messungen von Frequenzverhältnis und Zeitintervall.
Bereich: 10 Hz—10 MHz.

9 A

Eingang A. Signaleingang für Ereigniszählung, Messungen von Frequenz, Periodendauer, Frequenzverhältnis und Zeitintervall.
Bereich: 10 Hz—80 MHz.

10 < 100 kHz ~

Tiefpassfilter. Bei Messen von rauschgestörten Signalen mit einem Tastverhältnis von $\approx 0{,}5$ und einer Frequenz von < 100 kHz am Eingang A wird die Triggerung durch Drücken dieser Taste verbessert.

11 Funktionswählschalter

RATIO A/B

Einstellung auf Messung des Frequenzverhältnisses zwischen Signalen am Eingang A und Eingang B.
$n = 10^2$ und $n = 10^4$ sind Vervielfachungsfaktoren.

COUNT A

In dieser Stellung des Wählschalters summiert das Gerät die Impulse am Eingang A, solange die Taste START/STOP gedrückt ist

	FREQUENCY A	Einstellung auf Frequenzmessung am Eingang A. Die Meßeinheit der angezeigten Werte ist kHz. 0,1 s, 1 s und 10 s bezeichnen die Meßzeit.
	PERIOD A	Einstellung auf Messung der Periodendauer am Eingang A. Die Meßeinheit der Anzeigewerte ist 1 µs. $n=1$, $n=10^2$ und $n=10^4$ zeigen die Zahl der zu messenden Perioden an.
	TIME INTERVAL A—B	Einstellung auf Messung des Zeitintervalls von A bis B. Das Startsignal liegt am Eingang A, das Stoppsignal am Eingang B.
12	**MEMORY START/STOP**	Bei nicht gedrückter Taste wird die Meßanzeige bis Ende des nächsten Meßzyklus gespeichert. Bei gedrückter Taste folgt die Anzeige laufend den Dekadenzählern. Start/Stop-Betrieb, wenn der Funktionswählschalter auf COUNT A steht. Der Speicher ist dann ausgeschaltet.
13	**RESET**	Rückstellung von Dekadenzähler und Anzeige auf Null.
		Rückseite
14		Netzanschluss
15	**INT.BATT.OFF MAINS/EXT.BATT.**	Abschaltung der eingebauten Batterie. Das Gerät ist an das Netz oder eine äußere Batterie angeschlossen. Bei Netzanschluß wird die eingebaute Batterie aufgeladen.
15	**INT.BATT.ON**	Stromversorgung des Geräts durch die eingebaute Batterie. Netz oder äußere Batterie sind weggeschaltet.
16	**INPUT C**	Eingang C. Für externe Zeitbasissignale von 1 kHz—10 MHz.
17	**STD OUT**	Ausgang für signale des eingebauten Oszillators, oder des äußeren Frequenzstandards
18	**BCD**	BCD-Ausgang.
19	⏚	Gehäuseerdung.
20	—	Anschluß für Minuspol der äußeren Batterie.
21	+	Anschluß für Pluspol der äußeren Batterie.
22	**INT.STD EXT.STD IN VIA C**	Umschaltung auf internen oder externen Oszillator. (ältere Geräte haben interne Schaltbrücke)
23		Anschluss für D/A-Ausgang und BCD-Ausgang.
24	**B OUT**	Ausgang für normalisierte Signale des Eingangsverstärkers B.

VI. BETRIEB

Die Abbildungen VI-1 zu VI-4 an den Seiten 42 und 43.

Allgemeines

1. Inbetriebnahme

1.1. Netz

Vor Anschluß des Geräts an das Netz ist zu überprüfen, ob der Netztrafo der Netzspannung entsprechend geschaltet ist. Vgl. Abschnitt IV, INSTALLATION. Schalter MAINS EXT.BATT./INT.BATT.ON in Stellung MAINS EXT.BATT. bringen. ⓯.

Netzkabel einstecken ⓮.

Schalter DISPLAY TIME ❶ auf ON stellen. Überprüfen, ob die Lampe GATE ❷ und die Zifferanzeige leuchten und damit anzeigen, daß das Gerät eingeschaltet ist.

1.2. Äußere Batterie

Schalter MAINS EXT.BATT./INT.BATT.ON ⓯ in Stellung MAINS EXT.BATT. bringen.

Batteriekabel in Buchsen EXT.BAT. 12—24 V »+« ㉑ und »—« ⓴ einstecken.

Überprüfen, ob die Lampe GATE ❷ und die Zifferanzeige leuchten und anzeigen, daß das Gerät eingeschaltet ist.

1.3. Eingebaute Batterie PM 9673

Schalter MAINS EXT.BATT./INT.BATT.ON ⓯ in Stellung INT.BATT.ON bringen.

Überprüfen, ob Lampe GATE ❷ und die Zifferanzeige leuchten und anzeigen, daß das Gerät eingeschaltet ist. Bei blinkender Ziffernanzeige is die Batteriespannung zu niedrig. Die Bedienungsanleitung zur Batterie PM 9673 beschreibt die Aufladung.

2. Aufwärmzeit

Sieben Minuten nach Netzanschluß sind Geräte mit den geheizten Oszillatoren PM 9679 oder PM 9690 so weit aufgewärmt, daß der Oszillatorfehler weniger als 10^{-7} beträgt. Geräte mit den Oszillatoren PM 9677 oder PM 9678 (TCXO) sind sofort nach Netzanschluß betriebsbereit. Normalerweise werden die Geräte aus der Stellung STAND BY ❶ eingeschaltet. In diesem Fall ist keine Aufwärmzeit erforderlich, gleichgültig welcher Oszillator verwendet wird.

3. Externe Frequenz-Standards

Anstelle der Frequenz 10 MHz des eingebauten Oszillators können auch andere Frequenz-Normale verwendet werden. Falls eine Zeitauflösung von 100 ns erwünscht ist müssen 10 MHz verwendet werden.

Bei einer Frequenz von 1 MHz anstelle von 10 MHz ist der Dezimalpunkt zur Anzeigenkorrektur um eine Stelle nach links zu verschieben. Um das Gerät auf externe Normalfrequenz einzustellen, ist der obere Deckel abzunehmen und die Schaltbrücke SK 131 ㉒ in die Stellung EXT zu bringen.

Bei neueren Geräten ist dieser Schalter direkt an der Rückseite zugänglich.

Das Signal des Frequenz-Standards ist am Ausgang B OUT zugänglich.

Messungen

Die Abbildungen VI-1 zu VI-4 an den Seiten 42 und 43.

4. EIGENKONTROLLE

1. Die beiden Tasten CHECK ❼ ❿ drücken.
2. Schalter DISPLAY TIME ❶ in mittlere Stellung bringen.
3. Wählschalter ⓫ drehen und folgende Anzeigewerte ablesen:

Funktion	Anzeige (± 1 Ziffer)
FREQ 0.1 s	10000.00
FREQ 1 s	10000.000
FREQ 10 s	10000.0000
PERIOD n = 1	0.1
PERIOD n = 10^2	0.100
PERIOD n = 10^4	0.10000

4. Wählschalter ⓫ in Stellung COUNT A bringen.
5. Taste START/STOP ⓬ drücken: Das Gerät beginnt nun die Eingangsimpulse zu summieren und die Anzeige folgt der Zählung solange bis die Taste START/STOP ⓬ wieder gelöst wird.

5. FREQUENZ A

1. Schalter DISPLAY TIME ❶ in mittlere Stellung bringen.
2. Funktionswähler ⓫ auf die Frequenz einstellen, die der gewünschten Meßauflösung entspricht.
3. Das zu messende Signal an Eingang A ❾ legen.
4. Eingang des Geräts durch Drücken einer der Tasten ❹ ❻ ❼ ❿ an die Frequenz und das Tastverhältnis des zu messenden Signals anpassen.
5. Anzeige durch Nachregeln mit SENSITIVITY ❸ stabilisieren.

6. PERIODENDAUER A

1. Funktionswähler ⓫ je nach gewünschter Anzahl der zu messenden Perioden in eine der drei Stellungen PERIOD A bringen.
2. Eingang des Geräts durch Drücken einer der Tasten ❹ ❻ ❼ ❿ an die Frequenz und das Tastverhältnis des zu messenden Signals anpassen.

7. FREQUENZVERHÄLTNIS A/B

7.1. Normale Messung

1. Funktionswähler ⓫ je nach gewünschter Anzahl von Dezimalen auf der Anzeige in eine der beiden Stellungen RATIO bringen.
2. DISPLAY TIME ❶ in mittlere Stellung bringen.
3. Signal mit der höheren Frequenz an Eingang A ❾ legen.
4. Signal mit der niedrigeren Frequenz an Eingang B ❽ legen (max. 10 MHz).
5. Eingang des Geräts durch Drücken einer der Tasten ❹ ❻ ❼ ❿ an die Frequenz und das Tastverhältnis des zu messenden Signals anpassen.
6. Anzeige durch Nachregeln mit SENSITIVITY ❸ stabilisieren.

7.2. Vergrösserte Vervielfachungsfaktoren und Frequenzverhältnis B/A

(nur möglich in Zähler mit Ausgang B OUT an der Rückseite, Seriennummer SM2....).

1. Schalter ㉒ INT.STD/EXT.STD in Stellung EXT.STD legen.
2. Ausgang B OUT ㉔ mit Eingang INPUT C ⓰ an der Rückseite verbinden.
3. Das eine Signal (max. 80 MHz) an Eingang A und das andere Signal (max. 10 MHz) an Eingang B legen.
   Die Eingänge als unter 7.1.5. einstellen.
4. Funktionswähler ⓫ je nach gewünschter Anzahl von Dezimalen bringen laut der Tabelle unten.
   Die Lage des Dezimalpunktes muss korrigiert werden.

Einstellung	RATIO × Vervielfachungsfaktor	Anzahl von Dezimalen	
		Gezeigt	Korrekt
FREQ A 0.1 s	A/B × 10^6	2	6
1 s	A/B × 10^7	3	7
10 s	A/B × 10^8	4	8
PERIOD A n = 1	B/A × 1	1	0
n = 10^2	B/A × 10^2	3	2
n = 10^4	B/A × 10^4	5	4

8. IMPULSZÄHLUNG

1. Funktionswähler ⓫ auf COUNT A stellen.
2. Das zu messende Signal an den Eingang A ❾ legen.
3. Eingang des Geräts durch Drücken einer der Tasten ❹ ❻ ❼ ❿ an die Frequenz und das Tastverhältnis des zu messenden Signals anpassen.
4. DISPLAY TIME ❶ in mittlere Stellung bringen.
5. Taste START/STOP ⓬ drücken.
6. Nach Drücken der Taste START/STOP ⓬ beginnt das Gerät die Impulse des Eingangssignals zu zählen, bis die Taste wieder gelöst wird. Die Anzeige entspricht dann der Anzahl der Impulse, die vom Drücken bis zum Wiederlösen der Taste START/STOP ⓬ gezählt wurden.

9. ZEITINTERVALL A—B

1. 1. Funktionswähler ⓫ je nach gewünschter Auflösung in eine der beiden Stellungen TIME INTERVAL bringen.
2. Startsignal an Eingang A ❾ und Stoppsignal an Eingang B ❽ legen.
3. DISPLAY TIME ❶ in mittlere Stellung bringen.
4. Eingang des Geräts durch Drücken einer der Tasten ❹ ❻ ❼ ❿ an die Frequenz und das Tastverhältnis des zu messenden Signals anpassen.

Zur Beachtung: Bei gedrückter Taste ❿ wird das Signal am Eingang A um etwa 2 µs verzögert.

Notice d'emploi

I. INTRODUCTION — GENERALITES

Le PM 6612 peut mesurer la fréquence, la période, le rapport de fréquence, l'intervalle de temps et totaliser les mesures.
La gamme de fréquence est 80 MHz et la résolution de la mesure de l'intervalle de temps est de 100 ns.
Les accessoires optionnels, quatre différents oscillateurs, une batterie rechargeable, une sortie BCD et un convertisseur digital/analogique, élargissent encore le champ d'application.

II. CARACTERISTIQUES TECHNIQUES

Les propriétés exprimées en valeurs numériques avec indication de tolérance sont garanties. Les valeurs numériques sans tolérances ne sont mentionnées qu'à titre indicatif et correspondent aux caractéristiques d'un appareil moyen. Les valeurs numériques correspondent aux tensions secteur nominales.

A. MESURES

Fréquence

Gamme	10 Hz—80 MHz
Temps de porte	100 ms, 1 s et 10 s, INPUT A
Résolution	10 Hz, 1 Hz et 0,1 Hz
Précision	± 1 comptage ± erreur base de temps

Période simple A

Gamme	100 ns—100 s
Fréquence comptée	10 MHz
Résolution	100 ns
Précision	± 1 digit ± erreur de déclenchement* ± erreur temps de base

Période moyenne A

Gamme	onde sinusoidale: 10 Hz—10 MHz impulsions: 1 Hz—10 MHz
Nombre de périodes	$N = 10^2$ et 10^4
Résolution	$\frac{100\ ns}{N}$
Précision	± 1 digit ± erreur de déclenchement/N* ± erreur temps de base

* L'erreur de déclenchement est de ≤ 0,3 % pour les signaux dont le rapport signal/bruit est de ≥ 40 dB.

Intervalle de temps A—B

Gamme	100 ns—10^5 s
Fréquence comptée	10 MHz ou 10 kHz
Résolution	100 ns ou 100 µs
Temps mini stop-start	100 ns
Précision	± 1 digit ± erreur de déclenchement** ± erreur temps de base

Comptage A

Gamme	1 à 999999999
Mode	Accumule les impulsions durant l'intervalle de temps start-stop manuel.
Résolution de paire d'impulsions	12 ns

Rapport de fréquence A/B

Gamme	f_A : 10 Hz—80 MHz
Multiplicateur	f_B : 10 Hz—10 MHz
Précision	$N = 10^2$ et 10^4 avec positionnement décimal correct ± 1 digit de f_A ± erreur de déclenchement* f_B/N

Contrôle

10 MHz appliqués internement au canal A.
Toute fonction de mesure peut être sélectionnée

Fonctions auxiliaires

Remise à zéro	En appuyant sur le bouton « RESET » le compteur est remis à zéro. En relachant le bouton « RESET » une nouvelle mesure commence.
Mise en marche/Arrêt	En fonction « COUNT A » le temps de porte est contrôlé manuellement par le bouton « START/STOP ». La mémoire est automatiquement supprimée.
Temps d'affichage	Variable en continu de 0,2 à 5 s, infini lorsque le bouton « DISPLAY TIME » est tiré.
Disponibilité	Le commutateur est combiné à la commande du temps d'affichage. La position « STAND BY » maintient sous tension l'enceinte thermostatée.
Mémoire	Commutable par le bouton « MEMORY »

B. CARACTÉRISTIQUES D'ENTRÉE

Entrée A

Gamme	10 Hz à 80 MHz gamme globale, 10 Hz à 100 kHz lorsque le filtre passe-bas est sélectionné par le bouton « < 100 kHz »
Atténuation	Variable entre × 1 et × 20
Sensibilité	Onde sinusoidale: 10 mV_{eff}, moin 6 dB à 10 Hz Impulsions: $30mV_{pp}$ pour une largeur d'impulsion ≥ 6ns et un temps de montée ≤ 1ms
Impédance	1 MΩ//25 pF
Couplage	AC
Mode de déclenchement (niveau)	~ : pour des signaux ayant un facteur de forme compris entre > 25% et < 75% (passage par zéro) ⎍ : pour des signaux ayant un facteur de forme inférieur à > 25% (sur flanc avant) ⎍ : pour des signaux ayant un facteur de form supérieur à < 75% (sur flanc avant)

---

* L'erreur de déclenchement est de $\leq 3\times10^{-3}$ pour les signaux dont le rapport signal/bruit est de ≥ 40 dB.

** L'erreur de déclenchement de n'importe quelle forme d'onde est $\leq \pm \dfrac{2.5\times10^{-3}}{\text{pente signal (V/ns)}}$ ns

Protection de surcharge

Affaiblissement ×1	maxi 250 V DC ou 230 V_{eff} ≦ 440 Hz > 440 Hz: tombant à 12 V_{eff} à > 1 MHz
Affaiblissement ×20	maxi 250 V DC ou 230 V_{eff}

Entrée B

Gamme	10 Hz—10 MHz
Sensibilité	20 mV_{eff}
Impédance	1 M Ω/25 pF
Couplage	AC
Affaiblissement	variable entre × 1 et × 20
Mode de déclenchement (niveau)	~ : pour des signaux ayant un facteur de forme compris entre > 25% et < 75% (passage par zéro) ⎍ : pour des signaux ayant un facteur de forme inférieur à > 25% (sur flanc avant) ⎍ : pour des signaux ayant un facteur de form supérieur à < 75% (sur flanc avant)
Protection de surcharge	250 V DC ou 230 V_{eff} ≤ 440 Hz > 440 Hz : tombant à 12 V_{eff} à 1 MHz

Entrée C (à l'arrière)

Gamme	1 kHz à 10 MHz
Sensibilité	500 mV_{eff}
Couplage	AC
Impédance	≈ 10 kΩ
Protection de surcharge	50 V_{eff}
Oscillateur ext.	Via entrée C.

C. CARACTÉRISTIQUES DE SORTIE

STD OUT

Fréquence de sortie	fréquence de l'oscillateur interne (10 MHz) ou externe (1 kHz—10 MHz)
Niveau de signal	≈ 3 V_{p-p} (circuit ouvert)
Impédance de sortie	≈ 200 Ω (à l'épreuve des courts-circuits)
Couplage	DC

B OUT

Signal de sortie	signal normalisé de l'amplificateur B
Niveau de signal	≈ 3 V_{p-p} (circuit ouvert)
Impédance de sortie	≈ 220 Ω (à l'épreuve des courts-circuits)
Couplage	DC

Affichage	9 chiffres Tube indicateur plat à décharge gazeuse en 7 segments
Témoin de porte (GATE)	Indique que la porte principale est ouverte et que le comptage a lieu. En position STAND BY, la témoin indique que le compteur est raccordé au secteur ou à la tension de batterie.

D. CARACTÉRISTIQUES GÉNÉRALES

Oscillateur	Voir Accessories et notice d'entretien

Alimentation

Secteur	100—130 V ou 200—260 V, 50 à 400 Hz, 15 VA
Batterie externe	Tension +11.8 V à +28 V, consommation max. 1 A—0.5 A respectivement à 12 et à 24 V. Environ 100 mA en position « STAND BY » si le compteur est équipé d'une enceinte thermostatée
Batterie interne en option	PM 9673
Connecteur	Douilles bananes 4 mm

Conditions d'environnement

Température	
Stockage	—40° C à +70° C —40° C à +50° C (avec option batterie PM 9673)
Fonctionnement	0° C à +50° C (0° C à +40° C avec option batterie PM 9673)
Interférence secteur	meilleure que CISPR
Altitude	15000 m stockage 5000 m en fonctionnement
Humidité	humidité relative 90 % (point de rosée 26° C)
Résistance aux chocs	Conforme aux recommandations IEC 68 Eb
Résistance aux vibrations	Conforme aux recommandations IEC 68 F

Dimensions

Largeur	210 mm
Hauteur	89 mm
Profondeur	325 mm
Poids	2,8 kg env.

III. ACCESSOIRES

1. **Accessoires standard (compris à la livraison)**

1 câble secteur

1 notice d'emploi et d'entretien

1 fusible 1.6 « action rapide »

1 plaque « 115 V »

2. **Accessoires en option**

2.1. Oscillateurs

PM 9677 oscillateur standard

PM 9678 TCXO

PM 9679 enceinte thermostatée 1×10^{-7}/mois
PM 9690 enceinte thermostatée 1.5×10^{-9}/24 h

2.2. Unités de sortie

PM 9674 unité de sortie BCD

PM 9675 convertisseur digital/analogique

2.3. Accessoires d'entrée

PM 9351 sonde passive 10 MΩ/11 pF
220 MHz, atténuation 10×

PM 9353 sonde FET, 1 MΩ/3.5 F, 220 MHz

PM 9584 élément de mélange ohmique, 50Ω,
3 douilles BNC

PM 9346 active alimentation pour sonde active

2.4. Câbles coaxiaux

PM 9074 50Ω, BNC—BNC, longueur 1 m

PM 9588 jeu de câbles 50Ω, BNC—BNC :
5 câbles, longueur 20.7 cm
4 câbles, longueur 40.5 cm
3 câbles, longueur 60.3 cm
3 câbles, longueur 198.6 cm

2.5. Câble secteur

PM 9011 câble secteur 3 conducteurs

2.6. 19″ adapteur pour montage en rack
PM 9669/01 pour un compteur
PM 9669/02 pour deux compteurs

2.7. Unité de batterie
PM 9673 unité de batterie interne avec chargeur incorporé

2.8. Sac « toujors prét »
PM 9672

IV. INSTALLATION

1. Alimentation secteur

Le compteur peut être raccordé à deux tensions de secteur, 100—130 V et 200—260 V. La gamme de fréquence est entre 50 à 400 Hz. A la livraison, le compteur est cablé pour la gamme 200 à 260 V.
Pour raccorder le compteur à 100—130 V, changez les connexions du transformateur secteur selon la fig. IV-1, et recouvrez la plaque « 230 V » au moyen de la plaque fournie « 115 V ».

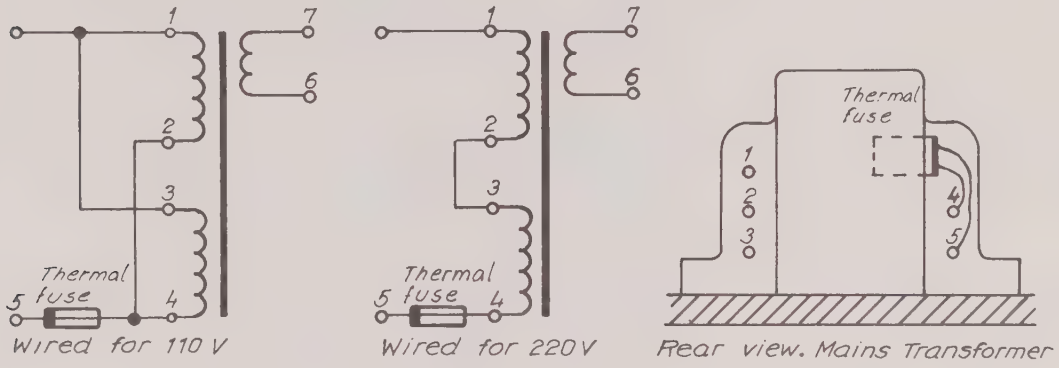

Fig. IV-1 : Connexions du transformateur secteur

2. Mise à la terre

Procédez à la mise à la terre conformément aux règlements de sécurité en vigueur. Deux méthodes sont possibles :

1. par l'intermédiaire de la borne de terre à l'arrière de l'appareil.
2. par l'intermédiaire du câble secteur à trois conducteurs enfiché dans une prise à contacts « terre » protecteurs.

NOTA : N'employez qu'une de ces solutions pour éviter la production de ronflements parasites !

3. Fusibles

L'alimentation est protégée par un fusible thermique sur le transformateur du secteur et un fusible 1.6 A, à action rapide, sur l'unité U1. Voir aussi figure VI-3 sur page 43.

4. Accessoires optionnels

Se référer aux instructions de montage données dans la notice de chaque accessoire.

V. ORGANES DE COMMANDE, INDICATEURS ET RACCORDS

Voir figures VI-1 à VI-4 sur pages 42 et 43.

1 DISPLAY TIME

Réglage de la durée d'affichage entre 0.2 et 5 s.
Lorsque le bouton est tiré, la durée d'affichage est infinie.
Lorsque le commutateur est placé en position STAND BY, le compteur est arrêté, à l'exception de l'enceinte thermostatée.
ATTENTION : La tension primaire de l'alimentation est appliquée !

2 GATE

La lampe indique que la porte principale est ouverte et que le comptage a lieu. Le bouton DISPLAY TIME étant en position STAND BY, la lampe GATE rest allumée et indique que l'enceinte thermostatée est en marche.

3 SENSITIVITY

Réglage de la sensibilité de l'entrée des canaux A et du canal B (texte orange). La commande A a deux gammes, 100 mV à 2 V environ (enfoncée) et 10 mV à 200 mV (tirée). La commande B a une gamme, 100 mV à 2 V.

4 ⊓

Pour mesurer des signaux à l'entrée A ou B avec un facteur de forme > 0.75 il faut actionner ce bouton pour assurer un déclenchement fiable.

6 ⊓

Pour mesurer des signaux à l'entrée A ou B avec un facteur d'utilisation < 0.25, il faut actionner ce bouton pour assurer un déclenchement fiable.

7 ∼

Pour mesurer des signaux à l'entrée A ou B avec un facteur d'utilisation 0.25—0.75, il faut actionner ce bouton pour assurer un déclenchement fiable.

7 10 CHECK

Auto-contrôle de l'appareil

8 B

Entrée B. Entrée de signal pour mesure RAPPORT DE FREQUENCE et INTERVALLE DE TEMPS.
Gamme : 10 Hz à 10 MHz.

9 A

Entrée A. Entrée de signal pour mesure COMPTAGE, FREQUENCE, PERIODE, RAPPORT DE FREQUENCE et INTERVALLE DE TEMPS.
Gamme : 10 Hz à 80 MHz.

10 < 100 kHz ∼

Filtre passe-bas. En mesurant des signaux à forts bruits à l'entrée A avec un facteur d'utilisation ∼ 0.5 et une fréquence < 100 kHz le déclenchement est amélioré en poussant ce bouton.

11 Sélecteur de fonction

RATIO A/B

Réglage du compteur sur mesure du rapport entre les signaux appliqués aux entrées A et B. $n = 10^2$ et $n = 10^4$ sont des facteurs de multiplication.

COUNT A

Le sélecteur étant en cette position, le compteur additionne les impulsions à l'entrée A pendant l'intervalle de temps entre l'enfoncement et le relâchement du bouton START/STOP.

FREQUENCY A	Réglage du compteur sur mesure de la fréquence à l'entrée A. kHz est une unité de mesure liée à l'affichage. 0.1 s, 1 s et 10 s sont les temps de porte.
PERIOD A	Réglage du compteur sur mesure de la période à l'entrée A. µs est l'unité de mesure reliée à l'affichage. $n=1$, $n=10^2$ et $n=10^4$ indiquent le nombre de périodes mis en moyenne.
TIME INTERVAL A—B	Réglage du compteur sur mesure de l'intervalle de temps A à B, avec signal start à l'entrée A et signal stop à l'entrée B.
⑫ **MEMORY START/STOP**	En position relâchée, l'information mesurée est mémorisée jusqu'à la fin du prochain cycle de mesure. En appuyant sur le bouton, l'affichage suit continuellement les compteurs à décades. En mode COUNT A, opération start/stop.
⑬ **RESET**	Remise à zéro du compteur à décades et de l'affichage.
	Panneau arrière
⑭	Entrée secteur.
⑮ **INT.BATT.OFF MAINS/EXT.BATT.**	Déconnecte la batterie interne. L'appareil est raccordé au secteur ou à la batterie externe. La batterie interne est chargée lorsque le câble du secteur est connecté.
⑮ **INT.BATT.ON**	L'appreil est alimenté à partir de la batterie interne. Le secteur ou la batterie externe sont coupés.
⑯ **INPUT C**	Entrée C. Entrée de signal pour signal externe base de temps de 1 kHz à 10 MHz.
⑰ **STD OUT**	Soutie pour le signal de l'oscillateur interne ou externe.
⑱ **BCD**	Raccord d'entrée de l'unité BCD.
⑲ ⏚	Mise à la terre du châssis.
⑳ —	Raccord du pôle négatif de la batterie externe.
㉑ +	Raccord du pôle positif de la batterie externe.
㉒ **INT.STD EXT.TSD IN VIA C**	Commute le compteur sur oscillateur interne ou externe
㉓	Raccord pour convertisseur continu-alternatif et unité BCD
㉔ **B OUT**	Sortie pour le signal normalisé de l'amplificateur B

VI. MANIPULATION

Voir figures VI-1 à VI-4 sur pages 42 et 43.

Généralités

1. Mise en route

1.1. Secteur

Avant de raccorder le compteur au secteur, contrôlez que le transformateur secteur est branché à la tension locale du secteur. Voir chapitre IV, INSTALLATION.
Commutateur MAINS EXT.BATT./INT.BATT.ON en position MAINS EXT.BATT. ⓯.
Raccorder le câble du secteur au compteur à ⓮.
Commutateur DISPLAY TIME ❶ sur ON. Contrôlez que la lampe GATE ❷ et l'affichage sont allumés, signalant que le compteur est branché.

1.2. Batterie externe

Commutateur MAINS EXT.BATTERY/INT.BATT.ON ⓯ en position MAINS EXT.BATTERY.
Raccorder les câbles de la batterie externe à la douille EXT.BATT. 12—24 V « + » ㉑ et « — » ⓴.
Contrôlez que la lampe GATE ❷ et l'affichage sont allumés, signalant que le compteur est branché.

1.3. Batterie interne PM 9673

Commutateur MAINS EXT.BATTERY/INT.BATTERY ON ⓯ en position INT.BATTERY ON.
Contrôlez que la lampe GATE ❷ et l'affichage sont allumés, signalant que le compteur est branché. Un affichage clignotant signale une tension trop basse. Voir notice d'emploi PM 9673, instructions de charge.

2. Temps d'échauffement

Les appareils équipés d'enceinte thermostatée PM 9697 ou PM 9690 ont un temps d'échauffement de moins de 7 minutes, après raccordement au secteur, pour obtenir une stabilité de 10^{-7}. Les compteurs équipés d'oscillateurs PM 9677 ou PM 9678 (TCXO) sont prêts à l'emploi dès raccordement au secteur. Normalement, l'appareil est branché en position STAND BY ❶. Dans ce cas, aucun temps d'échauffement n'est nécessaire, quelque soit l'oscillateur employé.

3. Fréquences externes standard

On peut utiliser d'autres fréquences standard à la place de la fréquence de 10 MHz de l'oscillateur interne. Pour un temps de résolution de 100 ns, il faut utiliser les 10 MHz.
En employant 1 MHz au lieu de 10 MHz, il faut décaler la virgule d'une position vers la gauche pour interpréter correctement l'affichage. Pour régler le compteur sur un standard externe, mettre le cavalier interne SK 131 ㉒ ou le commutateur SK 22 ㉒ au panneau arrière en position EXT.STD.
Le standard externe est disponible à la sortie B OUT.

Mesures

Voir figures VI-1 à VI-4 sur pages 42 et 43.

4. CONTRÔLE

1. Poussez les deux boutons CHECK ❼ ❿.
2. Commutateur DISPLAY TIME ❶ en position centrale.
3. Tournez le sélecteur ⓫ et relevez les valeurs d'affichage ci-après :

Fonction	Lecture (± 1 chiffre)
FREQ 0.1 s	10000.00
FREQ 1 s	10000.000
FREQ 10 s	10000.0000
PERIOD n = 1	0.1
PERIOD n = 10^2	0.100
PERIOD n = 10^4	0.10000

4. Commutateur ⓫ en position COUNT A.
5. Poussez le bouton START/STOP ⓬ : le compteur totalise les impulsions d'entrée et l'affichage suit continuellement le comptage jusqu'au relâchement du bouton START/STOP ⓬.

5. FREQ. A

1. DISPLAY TIME ❶ en position centrale.
2. Sélecteur de fonction ⓫ sur une des quatre positions de fréquence qui correspond à la résolution voulue de la mesure.
3. Appliquez le signal à mesurer à l'entrée A ❾.
4. Adaptez l'entrée du compteur à la fréquence et au facteur de forme du signal à mesurer en actionnant un des boutons ❹ ❻ ❼ ❿.
5. Réglez la commande SENSITIVITY ❸ pour stabiliser l'affichage.

6. PERIOD A

1. Sélecteur de fonction ⓫ sur une des trois positions de la PERIOD A en fonction du nombre voulu de périodes à mesurer.
2. Appliquez l'entrée du compteur à la fréquence et au facteur de forme du signal à mesurer en actionnant un des boutons ❹ ❻ ❼ ❿.

7. RAPPORT DE FRÉQUENCE A/B

7.1. Mesure normal

1. Sélecteur de fonction ⓫ sur une des deux positions RATIO en fonction du nombre voulu de décimales sur l'affichage.
2. DISPLAY TIME ❶ en position centrale.
3. Appliquez le signal avec la plus haute fréquence à l'entrée A ❾.
4. Appliquez le signal avec la plus basse fréquence à l'entrée B ❽.
5. Ajustez l'entrée du compteur à la fréquence et au facteur de forme du signal à mesurer en actionnant un des boutons ❹ ❻ ❼ ❿.
6. Réglez la commande SENSITIVITY ❸ pour stabiliser l'affichage.

7.2. Facteurs de multiplication augmentés et RATIO B/A

(valable que pour les compteurs munis d'une sortie B OUT latérale, préfix du numéro de série SM 2..).

1. Positionnez le sélecteur INT.STD/EXT.STD ㉒ sur EXT.STD.
2. Appliquez B OUT ㉔ avec INPUT C ⓰ à EXT.STD.
3. Appliquez le premier signal (max. 80 MHz) à l'entrée A et le second (max. 10 MHz) à l'entrée B.
   Appliquez les entrées du compteur aux signaux.
4. Positionnez le Sélecteur de Fonction ⓫ sur la position voulue, comme indiqué dans le tableau ci-dessus.
   Remarquez que la virgule est incorrectement visualisée.

Fonction	RATIO × Facteur de multication	Nombre de décimales	
		Lu	Correct
FREQ A 0.1 s	A/B × 10^6	2	6
1 s	A/B × 10^7	3	7
10 s	A/B × 10^8	4	8
PERIOD A n = 1	B/A × 1	1	0
n = 10^2	B/A × 10^2	3	2
n = 10^4	B/A × 10^4	5	4

8. TOTALISATION (COUNT A)

1. Sélecteur de fonction ⓫ en position COUNT A.
2. Appliquez le signal à mesurer à l'entrée A ❾.
3. Ajustez l'entrée du compteur à la fréquence et au facteur de forme du signal à mesurer en actionnant un des boutons ❹ ❻ ❼ ❿.
4. DISPLAY TIME ❶ en position centrale.
5. Enfoncez le bouton START/STOP.
6. Une fois le bouton START/STOP ⓬ enfoncé, le compteur commence à totaliser les impulsions d'entrée jusqu'au relâchement du bouton START/STOP ⓬. L'affichage indique le nombre d'impulsions comptées pendant l'intervalle de temps écoule entre l'enfoncement et le relâchement du bouton START/STOP ⓬.

9. INTERVALLE DE TEMPS A—B

1. Sélecteur de fonction ⓫ sur une des deux positions TIME INTERVAL en fonction de la résolution voulue.
2. Appliquez le signal start à l'entrée A ❾ et le signal stop à l'entrée B ❽
3. DISPLAY TIME ❶ en position centrale.
4. Ajustez l'entrée du compteur à la fréquence et au facteur de forme du signal à mesurer en actionnant un des boutons ❹ ❻ ❼ et ❿

Nota : Lorsque le bouton ❿ est actionné, le signal à l'entrée A est retardé de 2 µs environ.

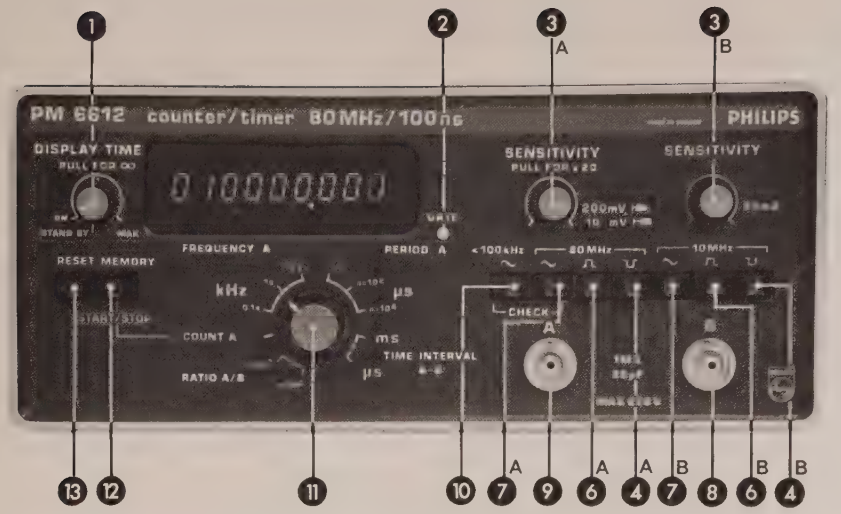

Figure VI-1. Front panel
Abbildung VI-1. Frontseite
Figure VI-1. Vue avant

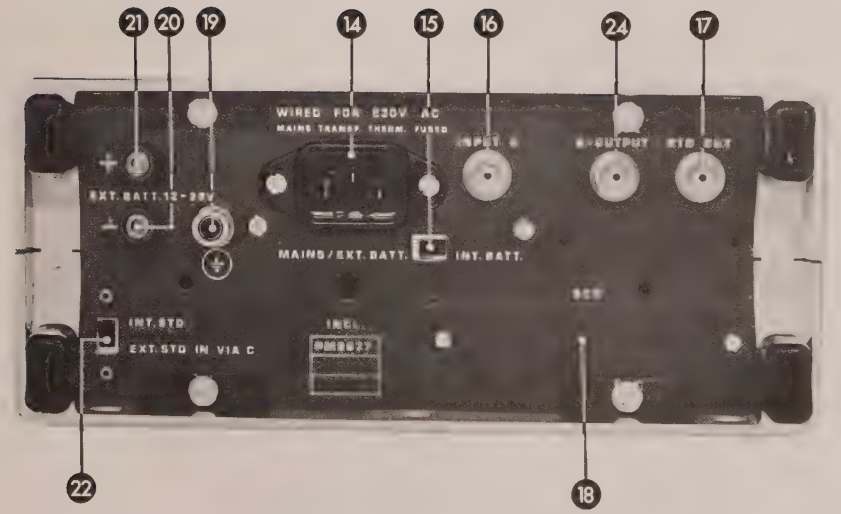

Figure VI-2. Rear panel
Abbildung VI-2. Rückseite
Figure VI-2. Vue arrière

Service manual

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VII. SURVEY OF CONNECTORS, SOCKETS, SWITCHES AND POTENTIOMETERS

BU 1	Input socket channel A
BU 2	Input socket channel B
BU 21	Input socket plus pole external battery
BU 22	Input socket minus pole external battery
BU 23	Mains input socket
BU 24	Input socket channel C
BU 25	Output socket, internal or external oscillator
BU 26	Earth clamp
BU 27	B OUT
BU 103	Connects oscillator to unit U1. Male
BU 104	Jumper connector for d.c. voltages. Male
BU 105	Connector for internal battery. Male
BU 106	Connector for BCD and D/A converter. Female
BU 107	Connector for d.c. voltages. Female
SK 22	EXTERNAL/INTERNAL STANDARD switch
SK 101	DISPLAY TIME switch
SK 102	STAND BY switch
SK 103	RESET switch
SK 104	MEMORY and START/STOP switch
SK 105	FUNCTION selector switch
SK 106	SENSITIVITY switch channel A
SK 107	LOW FREQUENCY FILTER switch channel A
SK 108	SINE WAVE triggering switch channel A
SK 109	POSITIVE PULSE triggering switch channel A
SK 110	NEGATIVE PULSE triggering switch channel A
SK 111	SINE WAVE triggering switch channel B
SK 112	POSITIVE PULSE triggering switch channel B
SK 113	NEGATIVE PULSE triggering switch channel B
SK 121	INTERNAL BATTERY/MAINS OR EXTERNAL BATTERY switch
SK 131	Jumper connector for EXTERNAL/INTERNAL STANDARD (only present in earlier version of the instrument)
R 107	SENSITIVITY potentiometer channel A
R 146	SENSITIVITY potentiometer channel B
R 1157	DISPLAY TIME potentiometer

VIII. CIRCUIT DESCRIPTION

1. 80 MHz input amplifier, channel A

Refer to the circuit diagram fig. XIII-3.

The measuring signal enters the amplifier at BNC socket INPUT A. The DC component of the signal is blocked by C 101. A two-position attenuator R 101, R 137, C 102, C 103 is controlled by switch SK 106. C 102 sets the frequency compensation.

Input protection is provided by R 102, C 104, R 103 and clipping diodes GR 101, 102, 103 and 106. Field-effect transistor TS 101 converts the input impedance together with emitter-follower TS 102 providing a low-ohmic output to the amplifier circuits. R 111, L 103 and C 132 form a 100 kHz low-pass filter which is operated with switch SK 107. R 107 sets the input sensitivity. When SK 107 is released, SK 108 has no function.

However, when both switches are depressed at the same time, the time base reference signal from IC 123:8 (see circuit diagram Time Base Dividers) is applied to the amplifier section via R 110, R 124, SK 107:3, 2 and SK 108:6, 5.

Switches SK 110 and SK 109 are principally polarity shifters selecting the normal (10) or inverting (9) input of line receiver IC 101.

When the input signal is a sine wave or pulses with the duty factor 25 to 75 %, both SK 110 and SK 109 should be released. The signal path is then from SK 108 through C 117, pins 8 and 7 of SK 110, and R 116 to the non-inverting input 10 of the first amplifier IC 101. The signal is available at both outputs 7 and 6.

When the input signal is a pulse train with a duty factor exceeding 75 %, switch SK 110 should be depressed. The signal now goes through pins 8 and 9 of SK 110 and via R 115 to the inverting input 9 of IC 101. The dc reference level is shifted outside the triggering window of the amplifier because pins 2 and 3 of SK 110 are connecting R 112 to earth.

SK 109 should be depressed when the input signal is a pulse train with duty factor below 25 %. Notice that SK 109 and SK 110 are interacting, so that SK 110 is automatically released when SK 109 is depressed. The signal path is now via C 117, pins 8 and 7 of SK 110. and R 116 to input 10 of IC 101. The only active function of SK 109 is to connect R 112 to earth to set the dc reference level of IC 101 outside the trigger window. Symmetrical feedback of the first amplifier stage IC 101 is provided by R 113 and R 114. At outputs 7 and 6, R 118 and R 119 are pull-down resistors for the emitter follower outputs.

The next amplifier stage of IC 101 with inputs 4 and 5 is not symmetrically fed back to prevent interference from Schmitt trigger TS 104, TS 103, from reaching the amplifier.

Output 3 provides the signal for Schmitt trigger TS 104, TS 103. GR 110 ensures temperature stabilisation. TS 105 is interfacing the Schmitt trigger output to TTL level. Before the choke L 101 at the collector of TS 105, the signal A 1 is taken out to the DCU. L 101 is filtering frequencies above 10 MHz. Output signal A 2 is used as the time base signal in the PERIOD mode.

2. 10 MHz input amplifier, channel B

Refer to the circuit diagram fig. XIII-3.

The measuring signal enters the input amplifier at input socket B. The DC component of the signal is blocked by C 113.

C 114 permits the higher frequencies to reach the clipping diodes GR 104 and GR 105.

Field effect transistor TS 106 provides impedance conversion. The gate and source signals having opposite polarity are fed to switch SK 113.

All switches SK 113, SK 112 and SK 111 are interacting, which means that the only function of SK 112 is to release SK 113 or SK 111.

When SK 113 is depressed, the drain of FET TS 106 is earthed via C 115 and SK 113:6, 5.

The signal from the source of TS 106 is fed via SK 113:3, 2 and variable resistor R 146, SENSITIVITY to the time base divider input B2.

When SK 113 is released, i.e. if either SK 112 or SK 111 is depressed, the signal with opposite polarity is fed from the drain of TS 106 via C 115, SK 113:1, 2 and to input B2 of the time base divider.

When SK 111 is released, a —5.2 V voltage is applied to B1 of the time base divider.

With SK 111 in depressed position, B2 is open.

3. Time base divider

3.1. General (Se circuit diagram fig. XIII-4)

A dual line receiver IC 120 is used to transfer the internal or external time base reference signal to the time base divider section.
The line receiver consists of two identical stages, each with a differential amplifier converting the input signal into appropriate TTL level, and a NAND gate controlled by the INT/EXT STD switch SK 22 and the Function switch SK 105.
In the FREQUENCY A mode using the internal oscillator, the 10 MHz signal from BU 103:5 is fed to input 2 of IC 120 via amplifier IC 102 and SK 22:1, 2. Next, the signal is fed to the NAND gate of IC 120. This gate is enabled by HIGH levels applied to control inputs 5 and 6 except in the RATIO mode, in which the gate is inhibited by a LOW level at pin 5.
From output IC 120:4 the 10 MHz signal is applied to input 9 of NAND gate IC 123. The second input 10 of this gate is HIGH in the FREQ mode. Rear output BU 25, STD OUT provides the 10 MHz signal for external use.
When an external time base is used, the signal applied to BU 24, INPUT C, is fed via SK 22, set to the EXT position, to input IC 120:2.
Via R 156 and R 152, the signal is fed to rear output BU 25, STD OUT.
Similar to the INT.STD mode, the external time base signal will be available at output IC 120:4, and fed to input 9 of the NAND gate IC 123.
Either the internal 10 MHz or the INPUT C signal is fed to input 4 og the AND/NOR configuration IC 121.
A time base reference signal is tapped off to the main gate (See circuit diagram "Decimal Counting Unit").
Control input 5 of IC 121 is HIGH in all modes except PERIOD A. In this mode, input IC 121:2 is HIGH, so that the A signal applied to input 3 can pass through. In the FREQUENCY mode, however, the gate IC 121:4, 5, is enabled and the signal can pass through via IC 121:6, IC 122:11, and R 134 to the time base dividers consisting of two LOCMOS quad decade counters IC 124 and IC 125.
The function of these circuits is described under section 4, Decimal Counting Unit.
The division factor is set with the Function switch SK 105 which controls the Decade Select inputs indicated M0, M1 and the Enable inputs as illustrated in the table below.
The divided signal corresponds to the D bit of the relevant decade counter and is available at terminal 18 of each circuit IC 124 or IC 125. Via transistor TS 120 it is fed to the AND-NOR configuration IC 121, input 13.
The second input 1 of IC 121 is HIGH in all modes except PERIOD A n = 1 and TIME INTERVAL "μs". In these modes input IC 121:10 is HIGH allowing the signal from IC 121:6 to pass through via IC 121:9 to output 8.
Next, the time base signal is gated through NOR gate IC 126:5. Input IC 126:6 is LOW except in the TIME INTERVAL mode. In all other modes, the signal passes through and is fed to input 10 of NAND IC 127 via inverter IC 126:1.
Output IC 127:8 controls clock input 3 of the main gate flip-flop IC 183. Its output 6 controls the main gate, whereas output 5 controls the gate indicator LED GR 189 via monostable multivibrator IC 182 and transistor TS 170. The second flip-flop of IC 183 is clocked at input 11 by the main gate flip-flop and is used as the display time flip-flop.

MODE	ENABLE IC 124	ENABLE IC 125	DECADE SELECT INPUTS			SELECT DECADE OF	
			M 0	M1 IC 124	M1 IC 125	IC 124	IC 125
RATIO A/B n = 10^4	H	L	H	H	L	D4	
RATIO A/B N = 10^2	H	L	H	L	L	D2	
COUNT A	H	L	H	L	L	D2	
FREQ. A 0.1 s	L	H	H	L	L		D2
FREQ. A 1 s	L	H	L	L	H		D3
FREQ. A 10 s	L	H	H	L	H		D4
PERIOD A n = 1	L	H	H	L	H		D4
PERIOD A n = 10^2	H	L	H	L	H	D2	
PERIOD A n = 10^4	H	L	H	H	L	D4	
T.I. A-B ms	H	L	L	H	L	D3	
T.I. A-B μs	H	L	L	H	L	D3	

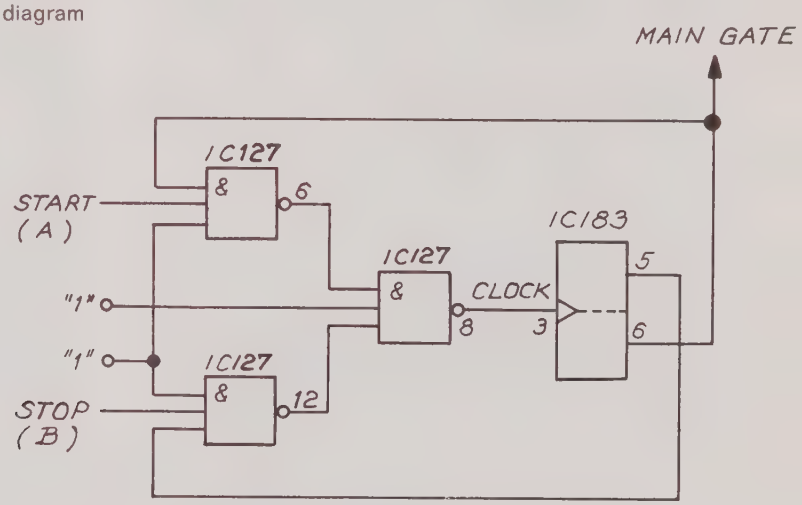
H = HIGH level, L = LOW level.

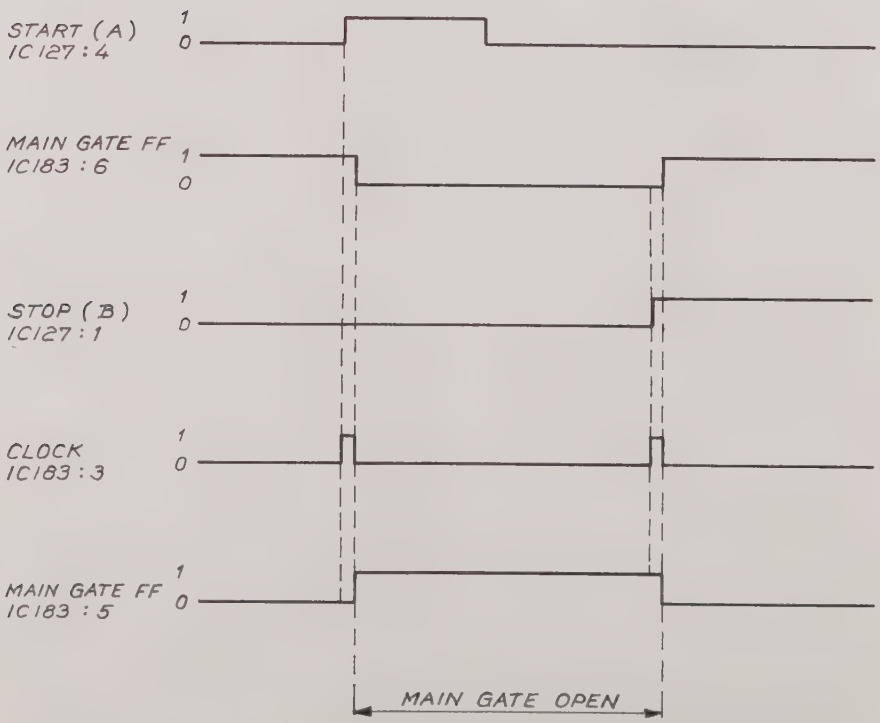
3.2. Time Interval mode

In this mode the signals from the A and B inputs are used as start and stop signals controlling the opening and closing of the main gate.
The start signal from input channel A is indicated A2 in the circuit diagram. It is fed via inverter IC 126:11, 13 to the start/stop gating network IC 127.
The stop signal from input channel B is indicated B2 in the circuit diagram.
Input B is either —5.2 V or open depending on the polarity chosen with SK 111, SK 112 or SK 113.
This control signal is used to bias the line receiver IC 101.
The measuring signal B2 passes IC 101 to the line receiver IC 120, input 12. This section of IC 120 is connected as a Schmitt trigger.
Output 9 provides the shaped signal partly to rear output B OUT, BU 27, via R 139, and partly to the start/stop gating network IC 127.
The function of the gating network and the main gate flip-flop IC 183 appears from the simplified diagram and the timing diagram illustrated below.

3.3. Ratio A/B

In this mode the higher frequency applied to input A is counted during an interval determined by the lower frequency applied to input B.
This means that the internal or external time base reference is disconnected. By setting the Function switch SK 105 to RATIO, pin 6 of wafer 3 is disconnected from the earthed pin 3.
Inputs 4 and 5 of NAND IC 122 go HIGH, and a LOW level is applied to input 5 of IC 120.
Consequently the oscillator signal path is inhibited. Simultaneously, input 2 of NAND IC 123 goes HIGH, allowing the B signal to pass on to input 10 of IC 123, and further to IC 121:4.
Next, the signal path goes to the time base divider IC 124 as described in section 3.1.





3.4 Synchronized preset

Refer to the simplified diagram fig. VIII-1.

During the display time interval, the time base dividers are preset to 9999. When the display time interval is ended and the RESET signal goes HIGH, the next clock pulse will trigger the decade counters of the time base dividers. Randomly, the display time interval may end during a clock pulse which might imply uncertain triggering of the dividers. To prevent this, the preset function is synchronized to the leading edge of he clock pulse.

The circuit achieving this consists of NAND gates IC 123 forming a latch configuration and NAND gate IC 122 with output terminal 3. The CLOCK signal applied to IC 122:12, 13 is also fed to IC 123:12. The RESET signal is applied to inputs IC 123:5 and IC 122:2. This means that the latch is controlled by the RESET signal. For example, when the RESET signal is LOW, output IC 122:3 providing the PRESET signal to IC 124:12 is HIGH, independent of the state of the CLOCK signal.

However, output IC 122:3 PRESET, goes LOW only when both inputs 1 and 2 go HIGH. This means, that when RESET goes HIGH during the time the CLOCK signal is also HIGH, input IC 122:1 is still LOW and the PRESET signal at IC 122:3 HIGH. But when the CLOCK signal goes LOW, the PRESET signal will be LOW.

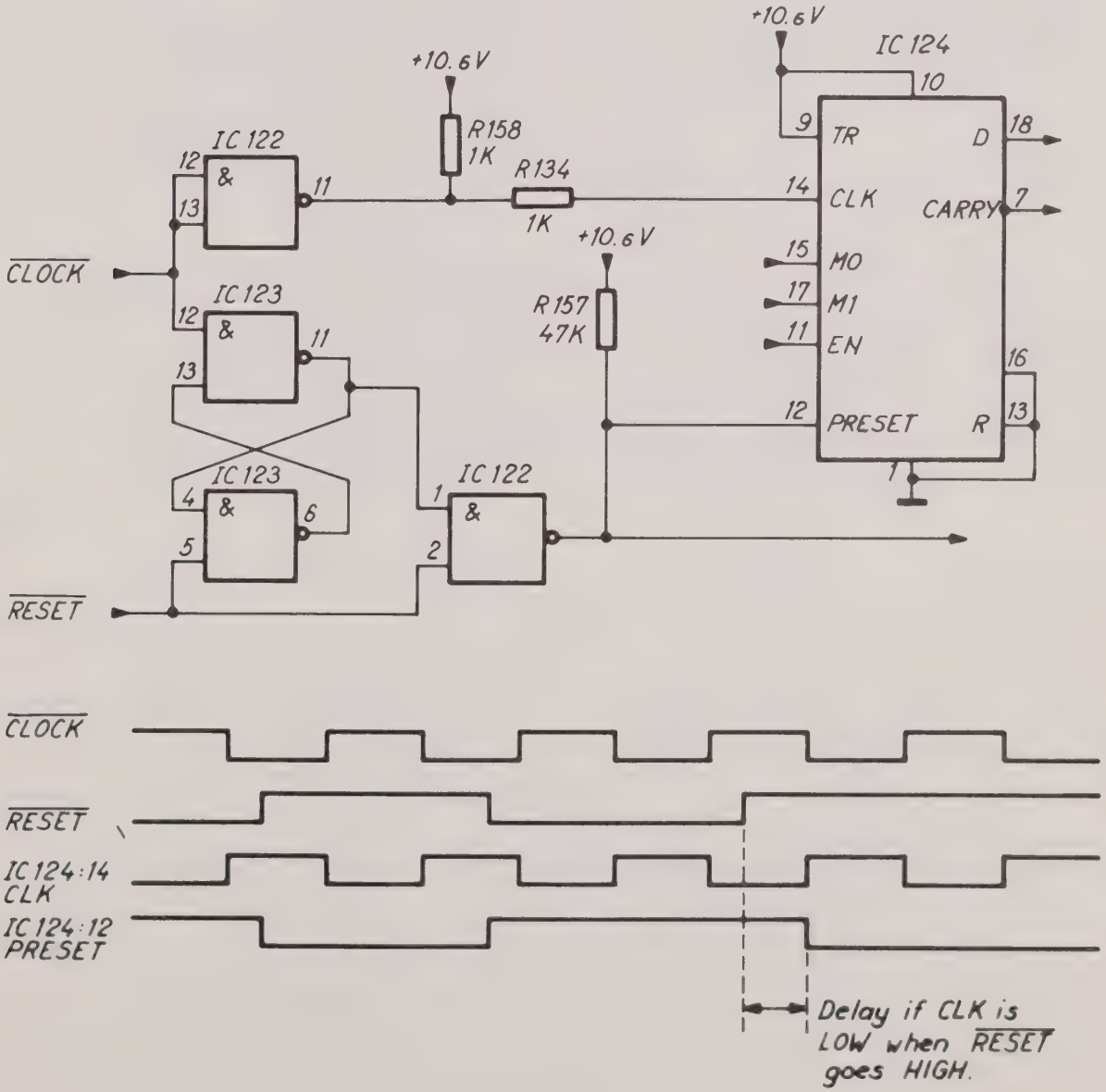


Fig. VIII-1. Preset sync circuit

3.5. Main gate and display time control

IC 183 is a dual D-flip-flop, containing the Main Gate FF and the Display FF. Both flip-flops are triggered by the positive going edge of their clock signal.
In all operating modes except COUNT A, a time base signal is applied to the clock input 3 of the Main Gate FF. The complementary output Q, pin 6, is connected to the main gate in the DCU section. The main gate is closed when Q is HIGH, but will open when Q goes LOW.
Assume that Q, pin 6, is HIGH. Then the D input pin 2 is also HIGH. At the next positive-going edge of the time base signal, output Q goes LOW and the main gate opens, i.e. the counting interval starts. The second output IC 183:5, Q, controls the Gate LED Multivibrator via input 13 of NOR gate IC 182. This monostable multivibrator controls the Gate LED GR 189 via TS 170. The LED can also be turned on by the front panel DISPLAY TIME switch when set to the STAND BY position. The monostable multivibrator is stretching the pulse at the shortest gate time settings so that the blinking of the LED becomes visible.
At the next positive-going edge of the clock signal at IC 183:3, the Main Gate flip-flop switches over, the complementary output IC 183:6 goes HIGH and the main gate is closed.
At this moment the display time interval starts. During this interval a TRANSFER pulse should be generated to the decade counters in the decimal counting unit, and a RESET pulse should be generated before the next counting interval starts.
The timing diagram fig. VIII-2 shows the sequence of these events. The Display Time flip-flop IC 183 is triggered by the positive-going edge of the MAIN-GATE signal from IC 183:6. Output IC 183:9 goes HIGH and provides a LOW CLEAR pulse to the Main Gate flip-flop input 1 via NOR gate IC 184:10. The output state of the Main Gate flip-flop is then maintained. The complementary output IC 183:8 of the Display Time flip-flop is LOW which normally would have set NOR gate output IC 185:10 to a HIGH level, causing the generation of a TRANSFER pulse via C 173 and R 1156. However, an INHIBIT LOW signal is assumed to be applied (e.g. from an automatic measuring system) via BU 106:5. Via IC 185:2 and 9, output 10 is latched to a LOW level until the INHIBIT signal goes HIGH. Then IC 185:10 goes HIGH and is latched to this state by the feed-back to input 3 eliminating the influence of another INHIBIT LOW signal that may appear. The positive-going edge is differentiated by C 173—R 1156, and a TRANSFER pulse is generated and fed to the DCU via IC 184:6. The positive-going edge from IC 185:10 is also fed to the Display Time multivibrator input IC 182:6 via R 1156. Capacitator C 172 starts charging and at the threshold level of IC 182:6, the multivibrator is triggered. Output IC 177:10 generates a sloping pulse which is converted to a proper RESET pulse at NOR gate output IC 178:13. Inverter IC 178:1 provides the RESET pulse to the DCU.

The RESET pulse is resetting the Time Base Dividers IC 124 and IC 125 via NAND gate IC 122, output 3. The Display Time flip-flop IC 183 is cleared by the RESET pulse at input 13, i.e. output IC 183:9 goes LOW. When the RESET pulse ends, the time base dividers generate clock pulses for the Main Gate flip-flop and the cycle is repeated. However, as illustrated in the second sequence of the timing diagram fig. VIII-2, the TRANSFER pulse appears immediately when the main gate is closing.

A third alternative occurs when the MEMORY push-button switch SK 104 is depressed, i.e. the memory is switched off. Then the main gate flip-flop output IC 183:6 is directly connected via pins 3 and 2 of SK 104 to input 5 of NAND gate IC 184. The TRANSFER pulse will then coincide with the main gate pulse plus the additional short pulse at the beginning of display time interval. Manual RESET is generated by push-button SK 103. Latch configuration IC 184:3 and 11 prevents contact bounce interference.

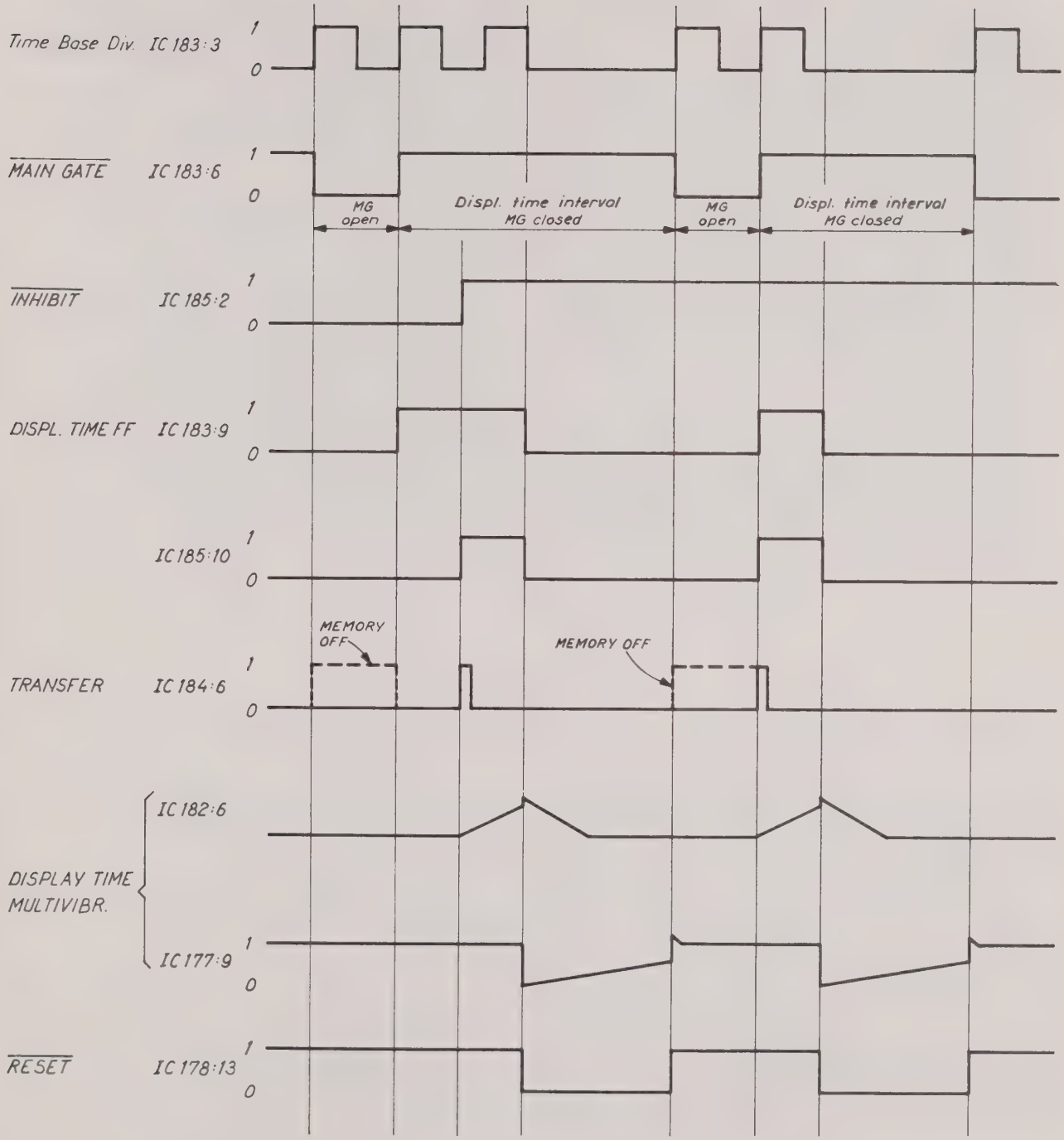


Fig. VIII-2. Timing diagram, main gate and display time control

4. Decimal counting unit—DCU—and display unit

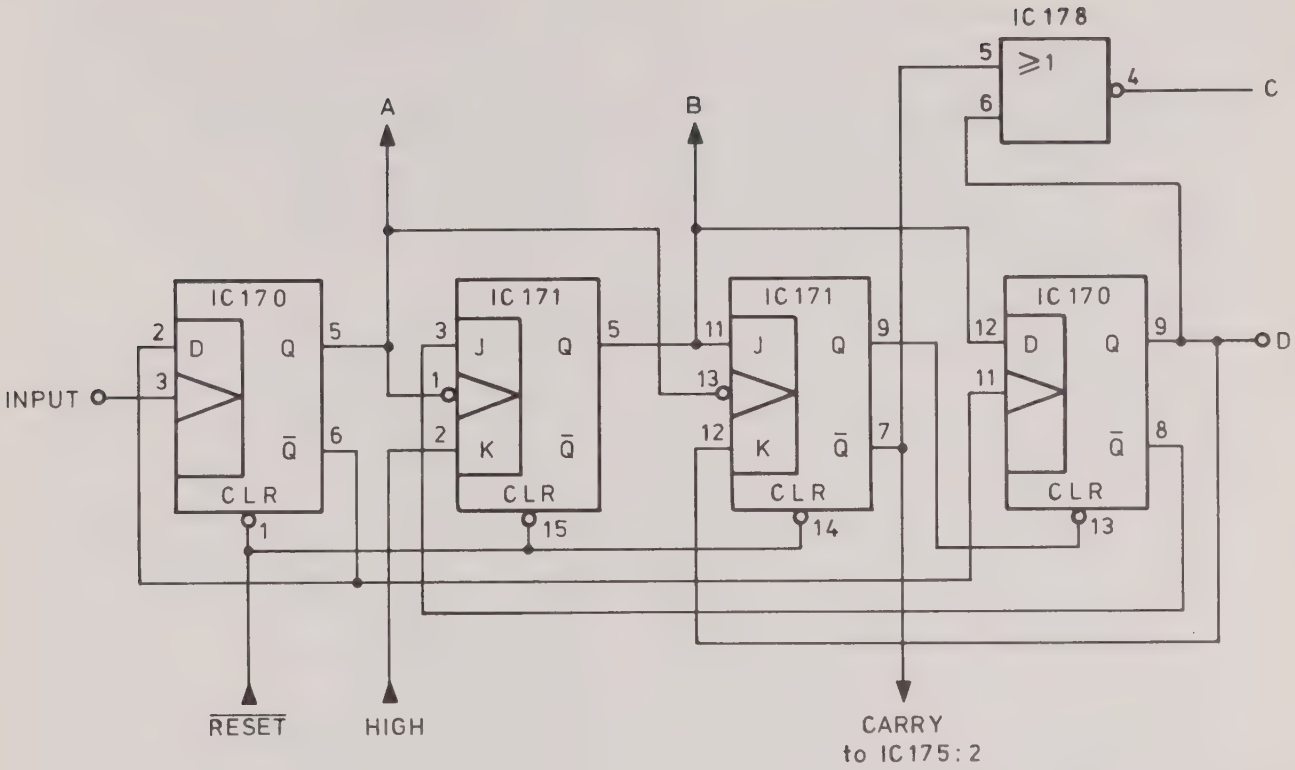
4.1. General

Refer to the circuit diagram fig. XIII-5.
The DCU consists of an 80 MHz decade IC 170, IC 171 for the least significant digit and two LOCMOS circuits IC 175, IC 176 each containing four complete decades. An address counter IC 179 generates the ENABLE signals for the 80 MHz decade the quad decades IC 175, IC 176 and also the scanning pulse sequence for the display via a BCD to 1 of 10 decoder IC 180.
The four-line BCD code provided by the decades is applied to the display via a BCD to 7 segment decoder IC 181. The outputs of this circuit are connected each to one segment of the 9 parallel connected digits including the decimal point.

4.2. 80 MHz decade

Refer to the circuit diagram fig. XIII-5 and the timing diagram fig. VIII-3.
2 D-type flip-flops IC 170, two edge-triggered JK flip-flops and a decoder NOR gate IC 178 form the 80 MHz decade. The input signal comes from the main gate IC 172 and triggers the first D flip-flop IC 170 which generates the A bit of the four-line BCD code. Next, the flip-flop IC 171 generates the B bit. When triggered by the negative edge of the A signal and the JK inputs are HIGH, i.e. when the complementary D bit at input J is HIGH. The K input is permanently HIGH.
The third flip-flop in the row, also a JK IC 171, produces the CARRY signal when triggered by the negative edge of the A pulse and the output of this flip-flop changes according to the state of the JK inputs at the time of triggering.
The fourth flip-flop, a D-type IC 170, produce the D bit at IC 170:9 when triggered by the complementary A bit assuming the B bit applied to the Data input IC 170:12 is HIGH.

Both the CARRY and D signals are applied to NOR gate decoder 1/4 IC 178 which generates the C bit as indicated in the timing diagram fig. VIII-3.
The four-line BCD information from the 80 MHz decade is then stored in the latch flip-flop IC 173. When the gate time ends, a TRANSFER pulse enables the latch which supplies the BCD data to the NAND gate network IC 174. These gates are inhibited until the ENABLE signal — D = HIGH — arrives from the address counter IC 179. When enabled, the BCD information are transferred via the data bus line to the BCD to 7 segment decoder IC 181. Refer to the timing diagram fig. VIII-4.



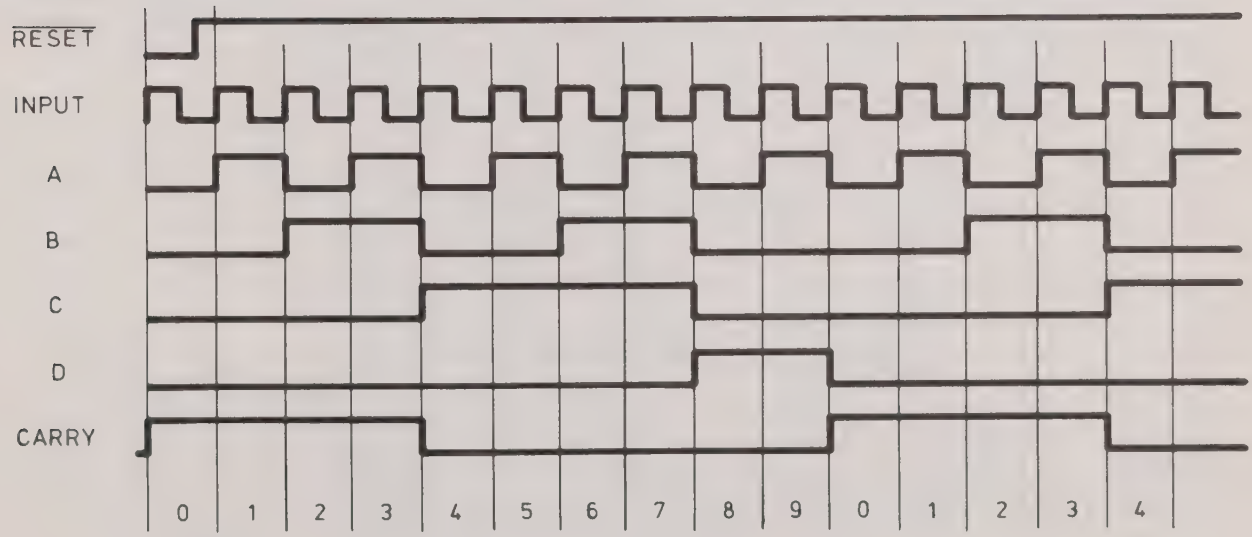


Fig. VIII-3. 80 MHz decade circuit and timing diagram

4.3. LOCMOS quad decades IC 175, IC 176

The CARRY signal from the 80 MHz decade is also used to clock the first decade counter of the LOCMOS circuit IC 175. This decade is referred to as D1 in the timing diagram fig. VIII-4.
DO indicates the 80 MHz decade just described. Each of the four decades contained in the LOCMOS circuit IC 175 or IC 176 functions principally as the 80 MHz decade. However, a brief look at the block diagram fig. VIII-5 will help understanding the special features. The PRESET input is permanently LOW and inactive because it is connected to—2.1 V. The CLOCK signal enters at input 14 and triggers the decades whose outputs are stored in the corresponding latches. When the TRANSFER pulse arrives, the information is fed to the multiplexer. Depending on the states of the Digit Select Inputs M0, M1, M2, the data of one of the decades is transferred to the BCD outputs provided the ENABLE input is HIGH. The truth table in figure VIII-5 indicates the relevant input states. Inputs M0 and M1 are addressed with BCD bits A and B respectively from the Address Counter IC 179. Input M2 is connected to—2.1 V and thus permanently LOW. The ENABLE signal to the first quad decade IC 175 is generated by NOR gate 1/4 IC 182 whose inputs are the C and D bits of the Address Counter IC 179. Thus, when both C and D are LOW as indicated in the timing diagram fig. VIII-4 the ENABLE signal to IC 175 goes HIGH. Assuming that both A and B of the Address Counter are LOW, decade D1 will provide its information to the BCD output and further to the BCD to 7-segment decoder IC 181. In the example given in the timing diagram fig. VIII-4 the digit next to the LSD will display a "2".
The next address from IC 179 will be A = HIGH, which means that the data of decade D2 is transferred to the BCD outputs and digit "0" is displayed. The sequence goes on until decade D4 has been selected. Then the ENABLE signal of IC 175 goes LOW because the C bit of the Address Counter goes HIGH. Instead, the ENABLE signal for quad decade IC 176 goes HIGH. Now the sequence starts again with the Digit Select Inputs M0, M1, M2 all being LOW thus selecting decade D5. Finally, decade D8 is selected corresponding to the Most Significant Digit, MSD.

4.4. Blanking

As indicated in the timing diagram fig. VIII-4, the output signals from the BCD to 7-segment decoder IC 181 contain blanking pulses between each digit information. The blanking is necessary to prevent unwanted glowing of unactivated segments of the display digit, and also to avoid the so-called streamers, which are glowings appearing between adjacent digits. In instruments with serial prefix 1, the blanking pulses are fed to the BCD to 7-segment decoder IC 181 only. From serial prefix 2, the blanking pulses are also applied to the anodes of the display B 101 via transistors TS 180 . . . TS 188.
The timing diagram fig. VIII-6 indicates how the blanking pulses are generated.
The pulses of the display multivibrator 2/6 IC 177 terminal 15 are fed to differentiating network R 191—C 140 via R 190 to the base of transistor TS 139. Its collector is connected to the blanking input 1 of IC 181 and, in instruments with serial prefix 2, via R 189 to the emitters of display driving transistors TS 180 . . . TS 188.
When the pulse on the base of TS 139 is positive the transistor will be turned off and the programmed current in the cathode driver will be zero.

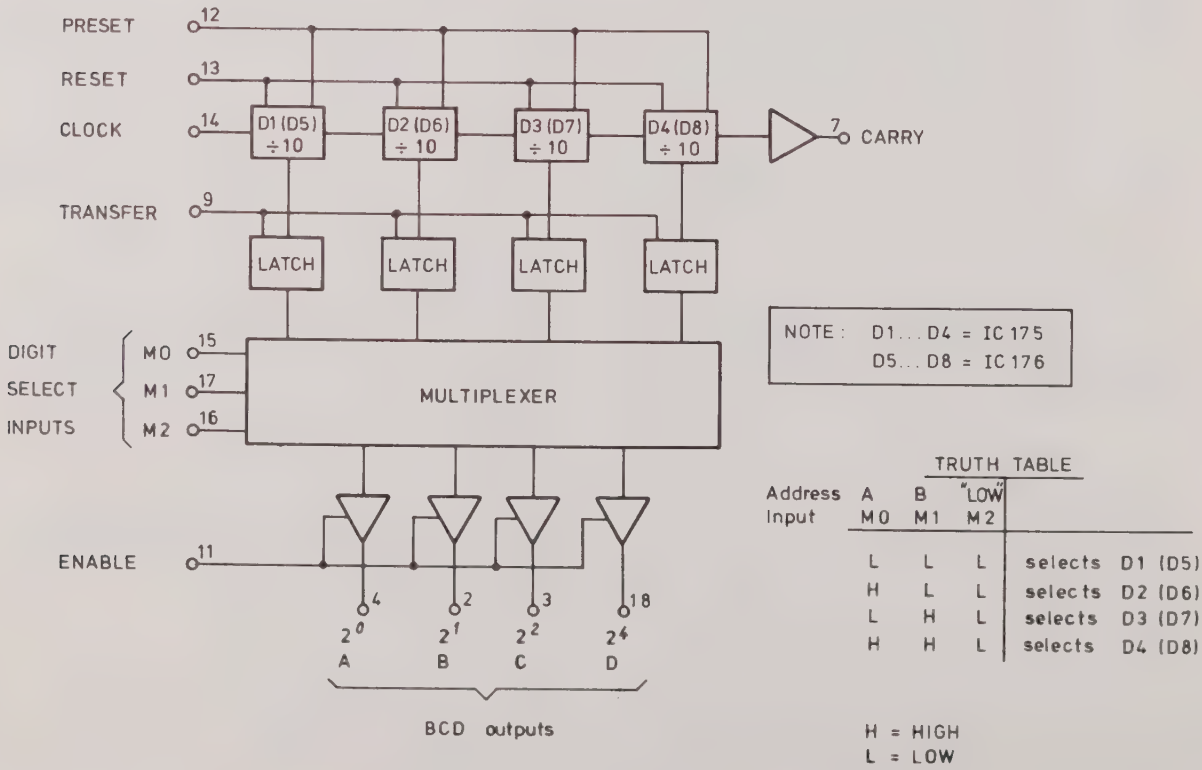


Fig. VIII-5. Block diagram of LOCMOS quad decade

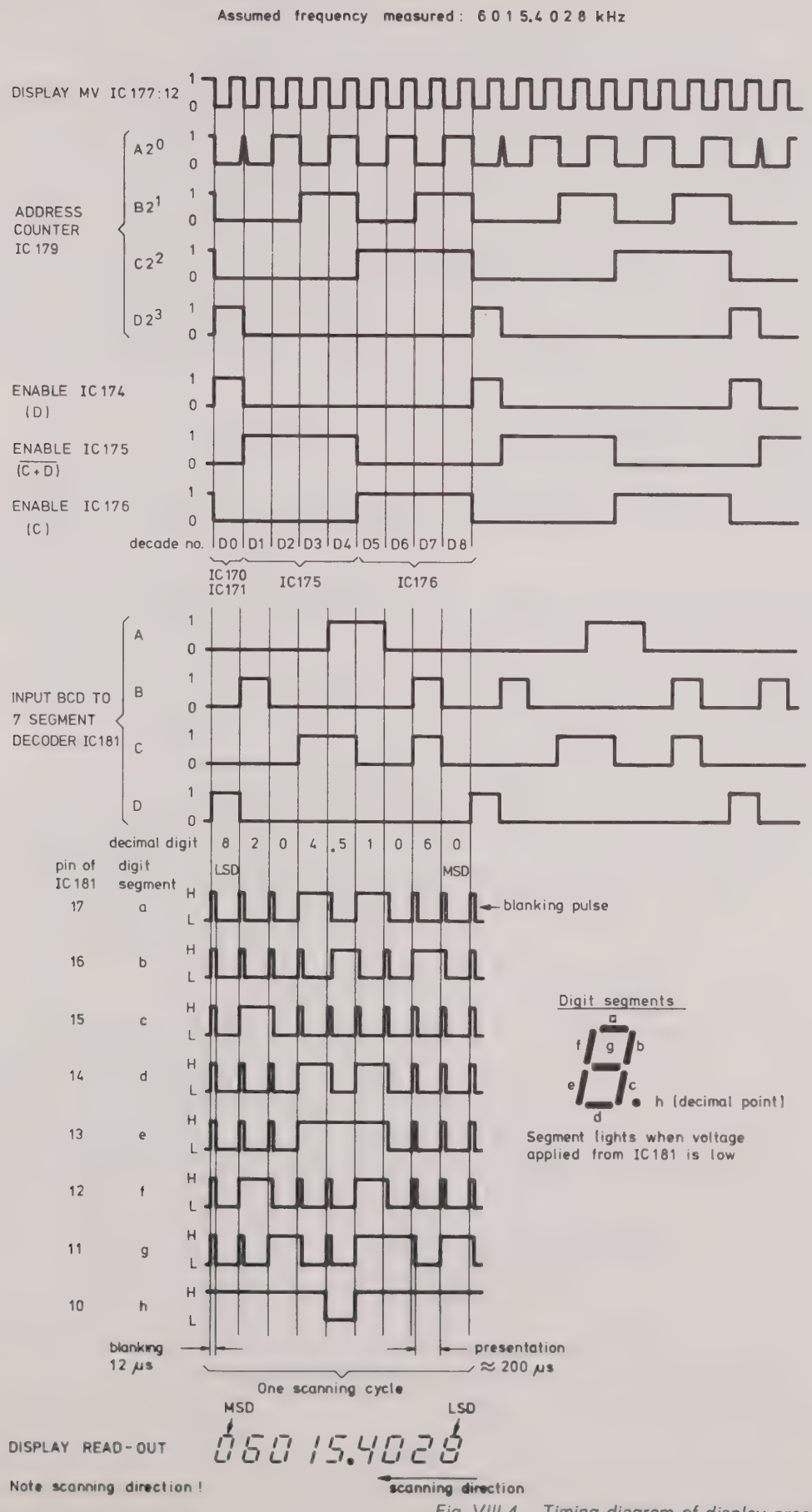


Fig. VIII-4. Timing diagram of display presentation

4.5. Display scanning

The display is scanned from the least significant digit —LSD— to the most significant digit—MSD. Only one digit lights at a time.
The pulse sequence controlling the driver transistors for the display digits is obtained from a BCD to 1 of 10 decoder IC 180 supplied with the four-line BCD information generated by the address counter IC 179. The timing diagram fig. VIII-6 illustrates how the digits are scanned. When output terminal 10 of the decoder IC 180 goes LOW, transistor TS 188 turns on and current can flow to the enabled segments of the least significant digit. Capacitor C 188 is connected between —50 V and +120 V and is changed to about 170 V which is sufficient to initiate a discharge of the segments of the display digit. The digit is presented during about 200 μs. At the next address from IC 179, output IC 180:10 goes HIGH again and output IC 180:1 goes LOW which is activating the next digit via TS 187. In the meantime, however, a 12 μs blanking pulse is generated by TS 139 which turns off all digits before the next digit segments are activated.
The scanning of the digits goes on until the most significant digit is turned on. Then the cycle starts all over again.

4.6. Decimal point setting

The Function Selector SK 105, controls the decimal point positioning in the display.
The decimal point input DP of the BCD to 7-segment decoder IC 181 is connected to pin 3 of SK 105 wafer 1. As indicated in the table in the circuit diagram fig. XIII-5 pin 3 will be connected to various outputs of the BCD to 1 of 10 decoder IC 180, except in mode COUNT A in which no decimal point is displayed. In mode FREQUENCY A and resolution 100 Hz, pins 3 and 4 are interconnected. When the "enable" pulse for digit number 4 arrives at output 4 of IC 180, it is also fed to the DP input of IC 181. A "decimal point pulse" is then fed from IC 181:10 to the decimal point 4 in the display.

5. Power supply

5.1. General

Refer to circuit diagram fig. XIII-6.

The power supply operates from 115 V AC or 230 V AC 50 to 400 Hz *or* from the internal battery PM 9673 *or* from an external battery with an output voltage of 12 to 28 V. It provides five stabilised and overload-protected voltages of +120 V, +12 V, +5 V, —5 V and —50 V.
The power supply may be divided into the *power input circuit* mainly consisting of the mains transformer T 101 and rectifier GR 167, the *over-voltage protection circuit* mainly consisting of thyristors TS 150, TS 151 and zener diode GR 160, the *voltage regulation circuit* mainly consisting of voltage regulator IC 150, thyristor TS 154, the*DC-to-DC converter* mainly consisting of primary side of transformer T 102, driver TS 152 and switch TS 153.

5.2. Power input circuit

When the power supply operates from the *mains*, the 115 V AC or 230 V AC is transformed to 20 V AC by transformer T 101, rectified in the diode-bridge GR 167, filtered by C 152 and C 161 and fed to the power supply circuits via switch SK 121 and SK 102.
When the power supply operates from an *external battery* the current to the power supply circuits is fed from BU 21 at the rear panel via protecting diode GR 164 and switches SK 121 and SK 102.
When the internal battery is used the current is fed from pin 8 of BU 105 via SK 121 and SK 102 to the power supply circuits.

5.3. Over-voltage protection

The over-voltage protection circuit consists mainly of thyristors TS 150, TS 151 and zener diode GR 160.
The anode of GR 160 is connected to the +5 V output from the power supply. If this voltage increases to 5.6 V . . . 5.8 V, the zener diode GR 160 will start to conduct and a current will flow through resistor R 1121. The voltage drop across R 1121 is fed to the gate of thyristor TS 151 via resistor R 1120. The anode is connected to the +5 V output voltage via resistor R 1118.
The thyristor will switch on and a voltage drop arises across resistor R 1122. This voltage is fed to the gate of thyristor TS 150, whose anode is connected to the d.c. input voltage. The thyristor will switch on and blow fuse VL 150, or, if the counter is operating in the internal battery mode, fuse VL 1 in the battery unit PM 9673. The capacitor across the gate and cathode of thyristor TS 151 prevents transients from the mains to blow fuse VL 150 accidentally.

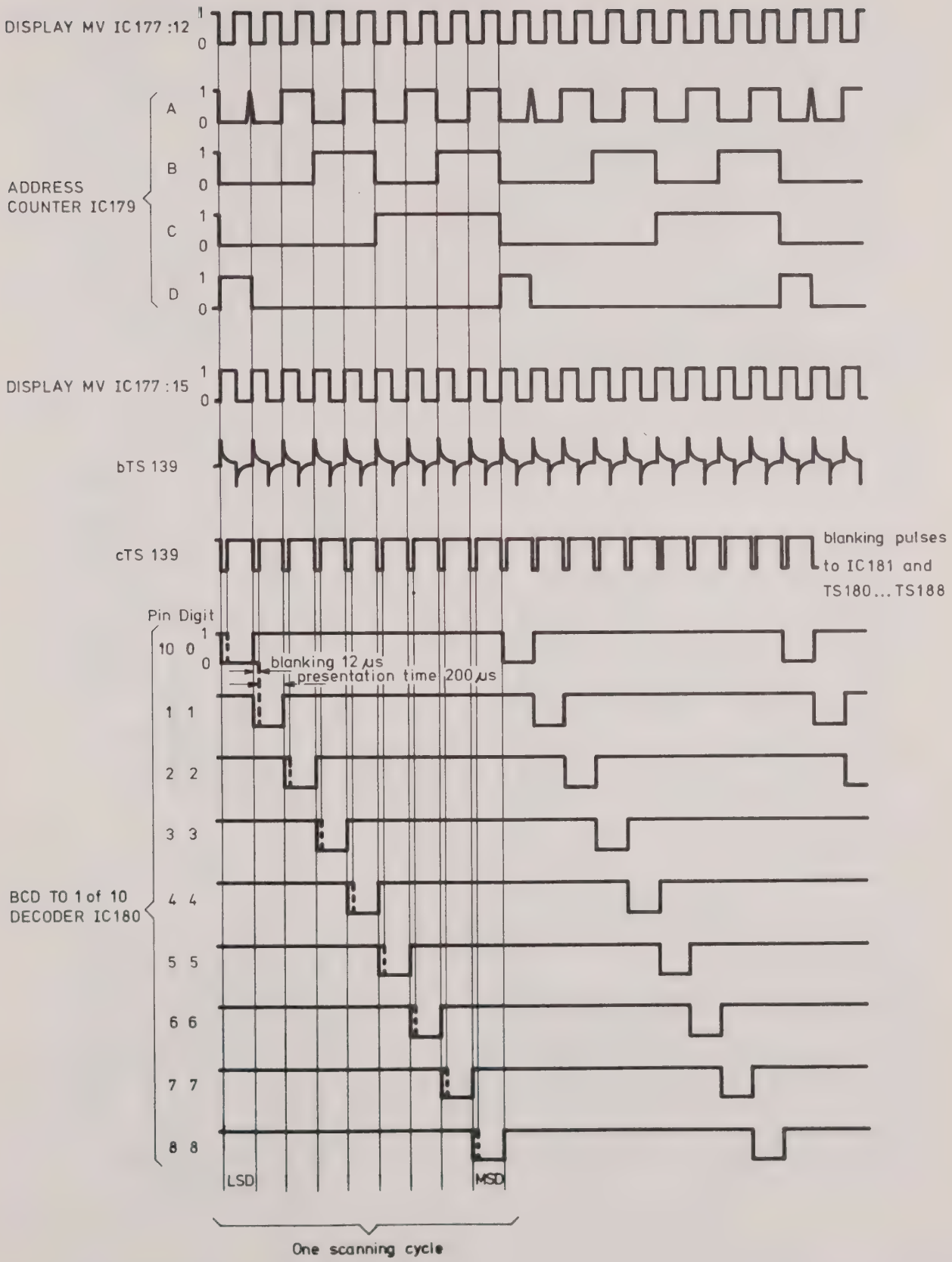


Fig. VIII-6. Timing diagram of display scanning principle and blanking pulse generation

5.4. *DC to DC converter*

Refer to diagrams fig. VIII-7.

The DC to DC converter is basically a blocking oscillator consisting mainly of switch transistor TS 153 and terminals 4—9 of the transformer T 102. When switch SK 102 is set to position ON, the DC voltage from the *power input circuit* is fed to the transistor TS 155 which works as a constant current source of approximately 1 mA (I_1).
The current I_1 will cause switch transistor TS 153 to start conducting and the linearly increasing current I_2 to flow.
This current I_2 will cause a voltage across terminals 3—8 of the transformer and the current I_3 will start to flow.
This will cause drive transistor TS 152 to saturate switch transistor TS 153. When the transistor no longer can saturate, current I_3 will stop to increase and the induced voltage at terminal 3 of transformer T 102 will disappear.
This will cause TS 153 to switch off and the collector voltage to rise to the same level as the supply voltage. At this moment the magnetic flux will discharge through the secondary windings of T 102 and diodes GR 155—159.

5.5. *Output voltage regulation circuit*

The output voltage regulation circuit consists mainly of voltage regulator IC 150 and thyristor TS 154.
The purpose of the thyristor TS 154 is to switch off the drive transistor TS 152 in order to regulate the output voltage. The switching moment of thyristor TS 154 is determined by a voltage at the gate of the thyristor which is the sum of a DC regulation voltage from terminal 10 of IC 150 and a sawtooth voltage caused by the emitter current of TS 153 through resistor R 1114//R 1115.
The voltage regulator IC 150 is fed at terminal 12 with the supply voltage and at terminal 7 with a negative voltage, via GR 161, from winding 3—8 of transformer T 102.
IC 150 contains a differential amplifier with inputs at terminals 4 and 5.
The input at terminal 5 is grounded via R 1104 and the input at terminal 4 is connected to a voltage divider that consists of the reference output at terminal 6 and the negative voltage from winding 3—8 of transformer T 102 at terminal 7.
The differential amplifier is in balance when the voltage at terminal 7 is —5 V. When the supply voltage across windings 4—9 of transformer T 102 increases, the voltage at the differential amplifier at terminal 7 of IC 150 will go more negative, the DC regulation voltage at terminal 10 of IC 150 will go positive and turn on thyristor TS 154. This will connect the base of driver transistor to the ground and cause switch transistor TS 153 to switch off. The stored magnetic flux will then discharge in the secondary windings of T 102 and diodes GR 155—GR 159.

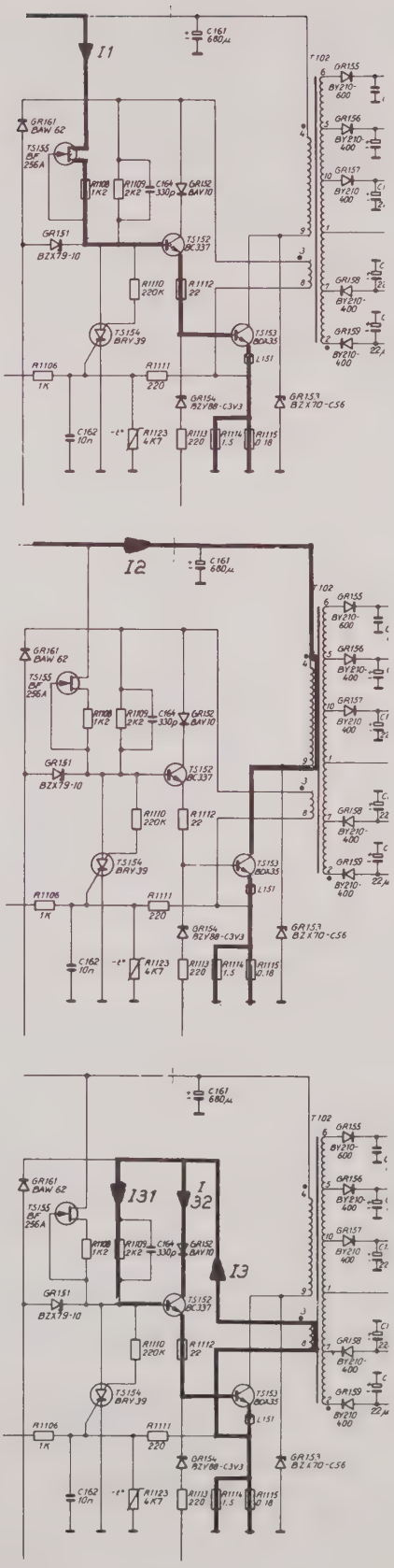


Fig. VIII-7. Current paths in DC-to-DC converter

IX. PERFORMANCE CHECK

1. Survey of check points

3. CHECK
4. RESET
5. DISPLAY TIME
6. MEMORY
7. PERIOD A
8. COUNT A START/STOP
9. RATIO A/B
10. INPUT B. Trigger mode selectors and sensitivity controls
11. TIME INTERVAL A/B
12. INPUT A. Low frequency filter and trigger mode selectors and attenuators
13. FREQUENCY A. Frequency response, sensitivity and sine wave trigger selector
14. INPUT A. Low frequency filter and square wave trigger selectors
15. INPUT A. Attenuator
16. B-OUTPUT
17. INPUT C. Frequency range and sensitivity
18. STD OUT
19. Temperature compensated crystal oscillator PM 9678
20. Oven enclosed oscillator PM 9679 and PM 9690
21. Standard oscillator PM 9677

2. Test equipment and accessories

Test-point	*Instrument or device*	*Required data*	*Recommended model*
9, 10	LF generator	Frequency: 10 MHz Amplitude: 0.5 V Signal mode: sine wave	Philips PM 5145
9, 10, 17	T-piece	BNC	Philips PM 9067
13	LF generator	Frequency: 10 Hz—1 kHz Amplitude: 20 mV Signal mode: sine wave	Philips PM 5145
13	HF generator	Frequency: 10 MHz—80 MHz Amplitude: 20 mV Signal mode: sine wave	Wavetek 2001
14	LF generator	Frequency: 100 kHz—5 MHz Amplitude: 300 mV Signal mode: sine wave	Philips PM 5145
14	HF oscillator	Frequency: 80 MHz Amplitude: 3 V Signal mode: sine wave	General Radio 1215
10, 14	Pulse generator	Frequency: 5 MHz Duration: 6 ns Amplitude: 60 mV	Philips PM 5715
14	Attenuator	20 dB	Texscan FP50 BNC Outline A
15	LF generator	Frequency: 1 kHz Amplitude: 200 mV Signal mode: sine wave	Philips PM 5145
15	HF generator	Frequency: 80 MHz Amplitude: 200 mV Signal mode: sine wave	Wavetek 2001
16	LF generator	Frequency: 3 MHz Amplitude: 20 mV Signel mode: Sine wave	Philips PM 5145
17	LF generator	Frequency: 10 MHz Amplitude: 0.6 V Signal mode: sine wave	Philips PM 5145
17, 18	Oscilloscope	Bandwidth: 50 MHz	Philips PM 3250
18	Probe to BNC conversion bush	5 kohm, 100 × attenuation	Included in Philips PM 9343
19	Reference oscillator	Accuracy 1×10^{-7}	Philips PM 9680*, PM 9681* and PM 9690*
20	Reference oscillator	Accuracy 3×10^{-8}	Philips PM 9680*, PM 9681* and PM 9690*
20	Reference oscillator	Accuracy 1×10^{-9}	HP 105*
20	Sampling oscilloscope	Bandwidth > 1 GHz	Philips PM 3400
21	Reference oscillator	Accuracy 1×10^{-6}	Philips PM 9680*, PM 9681* and PM 9690*

* To be checked against a frequency standard such as Droitwich or HBG.

3. CHECK

3.1. Set the controls of the counter:

DISPLAY TIME ❶	mid position
CHECK ❼ ❿	depressed
FUNCTION ⓫	0.1 s

3.2. Rotate FUNCTION selector ⓫ and check displayed value and GATE lamp ❷.

Function selector	*Display read-out ± 1 digit*	*Gate lamp is on during:*
0.1 s	10000.00	100 ms
1 s	10000.000	1 s
10 s	10000.0000	10 s
n = 1	0.1	—
$n = 10^2$	0.100	≈ 100 ms
$n = 10^4$	0.10000	≈ 100 ms

4. RESET

4.1. Set the controls of the counter:

FUNCTION ⓫	1 s
CHECK ❼ ❿	depressed
DISPLAY TIME ❶	mid position

4.2. Check that display read-out is 10000.000 ± 1 digit and that GATE lamp ❷ is turned on during one second.

4.3. Pull DISPLAY TIME switch ❶ and depress RESET push-button ⓭. Check that GATE lamp ❷ is turned off and that display read-out is 0.000.

4.4. Release RESET push-button ⓭ and check that display read-out is 10000.000 ± 1 digit and that GATE lamp ❷ is turned on once during one second.

5. DISPLAY TIME

5.1. Set the controls of the counter:

FUNCTION ⓫	1 s
CHECK ❼ ❿	depressed
MEMORY ⓬	released
DISPLAY TIME ❶	depressed, position ON

5.2. Check that display read-out is 10000.00 ± 1 digit and that flashing frequency of the GATE lamp ❷ is approximately five flashes every second.

5.3. Rotate DISPLAY TIME potentiometer ❶ slowly from position ON to position MAX and observe how flashing frequency of the GATE lamp ❷ decreases to approximately one flash every five seconds in position MAX.

5.4. Pull DISPLAY TIME switch ❶ and check that display shows 10000.00 ± 1 digit and that GATE lamp ❷ is turned off.

6. MEMORY

6.1. Set the controls of the counter:

FUNCTION ⓫	10 s
CHECK ❼ ❿	depressed
DISPLAY TIME ❶	mid position
MEMORY ⓬	depressed

6.2. Observe the display and check that the counter is counting during 10 seconds and shows 10000.0000 ± 1 digit during approximately one second.

6.3. Observe the GATE lamp ❷ and check that it is turned on during the counting time (10s) and turned off during the time the result is presented at the display (1s).

6.4. Release MEMORY push-button ⓬ and check that the display shows 10000.0000 ± 1 digit permanently.

7. PERIOD A

Test set up

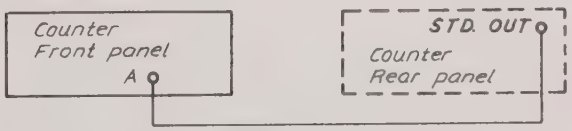
7.1. Set the controls of the counter:

DISPLAY TIME ❶	position ON
FUNCTION ⓫	PERIOD A, $n = 10^4$
TRIGGER SELECTOR A ❼	depressed
MEMORY ⓬	released
SENSITIVITY A ❸	fully CW

7.2. Check that display read-out is 0.10000 ± 1 digit.

8. COUNT A START/STOP

Test set up



8.1. Set the controls of the counter:

DISPLAY TIME ❶	position ON
FUNCTION ⓫	COUNT A
MEMORY ⓬	released (position STOP)
SENSITIVITY A ❸	pulled
TRIGGER SELECTOR A ❼	depressed

8.2. Depress push-button MEMORY ⓬ (position START) and check at the display that the counter is adding the input pulses.

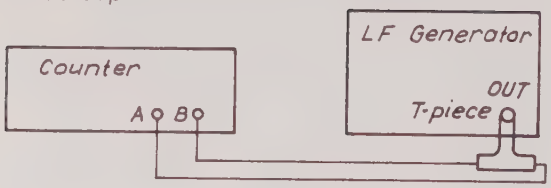
8.3. Release push-button MEMORY ⓬ (position STOP) and check at the display that the counter stops adding. The display is now showing the amount of pulses counted in the time interval between depressing and releasing the push-button MEMORY ⓬ (START/STOP).

8.4. Depress push-button RESET ⓭ and check that display shows zero.

8.5. Pull switch DISPLAY TIME ❶ and repeat steps 8.2 to 8.4.

9. RATIO A/B

Test set up



9.1. Set the controls of the counter:

FUNCTION ⓫	RATIO n = 10^2
DISPLAY TIME ❶	position ON
TRIGGER SELECTOR A ❼	depressed
SENSITIVITY A ❸	pulled
SENSITIVITY B ❸	fully CW

9.2. Set the controls of the low frequency generator.

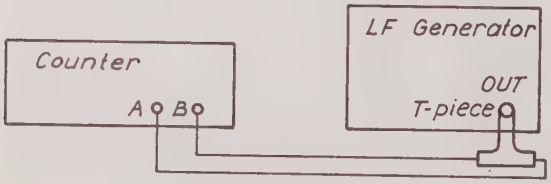
Frequency:	10 MHz
Amplitude:	20 mV
Signal mode:	Sine wave

9.3. Check that display read-out is 1.00 ± 1 digit.

9.4. Set FUNCTION selector ⓫ to position n = 10^4. Check that display read-out is 1.0000 ± 1 digit.

10. INPUT B. Trigger mode selectors and sensitivity controls

Test set up



10.1. Set the controls of the counter:

DISPLAY TIME ❶	position ON
FUNCTION SELECTOR ⓫	RATIO n = 10^2
TRIGGER SELECTOR A+B ❼	depressed
SENSITIVITY A ❸	fully CW, pulled
SENSITIVITY B ❸	fully CW

10.2. Set the controls of the generator:

Amplitude:	30 mV
Frequency:	100 Hz
Signal mode:	Sine wave

10.3. Check that display read-out is 1.00 and that the counter is gating.

10.4. Slowly decrease the amplitude of the signal from the generator until display read-out becomes wrong or the counter stops gating. Stop.
Slowly increase the amplitude until display read-out becomes correct and the counter is gating. Stop.

10.5. Check that the amplitude of the signal is less than 20 mV.

10.6. Set the frequency of the generator to 10 MHz and the amplitude to 20 mV

10.7. Repeat steps 10.3. and 10.4.

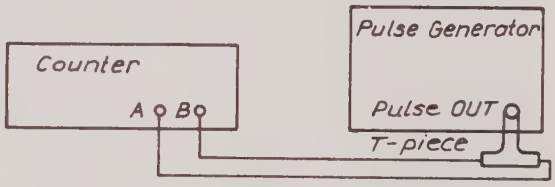
10.8. Check that the signal is less than 20 mV.

10.9. Turn SENSITIVITY B potentiometer ❸ fully CCW and set the amplitude of the generator to 500 mV.

10.10. Repeat steps 10.3. and 10.4.

10.11. Check that the amplitude is ≦ 400 mV.

Change test set up



10.12. Set the controls of the counter:

TRIGGER SELECTOR A+B ❻	depressed
SENSITIVITY B ❸	fully CW
FUNCTION SELECTOR ⓫	RATIO n = 10^2
TRIGGER SELECTOR A+B ❼	depressed
DISPLAY TIME ❶	position ON

10.13. Set the controls of the pulse generator

Frequency:	100 kHz
Amplitude:	100 mV
Duration:	50 ns

10.14. Repeat steps 10.3. and 10.4.

10.15. Check that the signal is less than 60 $mV_{p\text{-}p}$.

10.16. Depress trigger selectors A+B ❹.

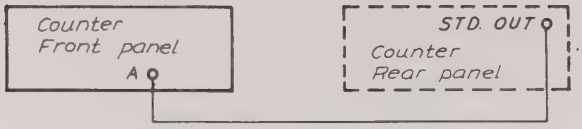
10.17. Set the amplitude of the pulse generator to 100 $mV_{p\text{-}p}$ and inverted pulse mode.

10.18. Repeat steps 10.3. and 10.4.

10.19. Check that the signal is less than 60 $mV_{p\text{-}p}$.

11. TIME INTERVAL A/B

Test set up



11.1. Set the controls of the counter:

FUNCTION SELECTOR ⓫	TIME INTERVAL ms
MEMORY ⓬	depressed
SENSITIVITY A+B ❸	fully CW
TRIGGER SELECTOR A+B ❼	depressed
DISPLAY TIME ❶	position ON

11.2. Check that the counter is counting, that the gate lamp is on and that the 5:th digit from the left is changing every second.

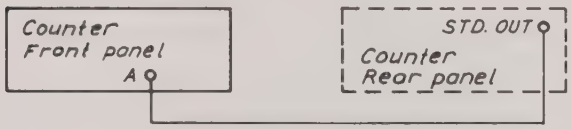
11.3. Disconnect the signal to INPUT A and check that the counter keeps on counting.

11.4. Connect the signal from STD OUT to INPUT B and check that the counter stops counting and that gate lamp turns off.

11.5. Set FUNCTION SELECTOR to position TIME INTERVAL μs and repeat steps 11.2. to 11.5. This time, however, the second digit from the left should change every second.

12. INPUT A with low frequency filter, trigger mode selectors and attenuator

Test set up



12.1. Set the controls of the counter:

DISPLAY TIME ❶	position ON
FUNCTION ⓫	1 s
TRIGGER SELECTOR A ❼	depressed
SENSITIVITY A ❸	fully CW, depressed

12.2. Check that display read-out is 10000.000. Depress LOW FREQUENCY FILTER push-button ❿ and check that display read-out is 0.000.

12.3. Depress TRIGGER SELECTOR push-button ❼ and set FUNCTION SELECTOR rotary switch ⓫ to position 0.1 s. Check that display read-out is 10000.00.

12.4. Turn SENSITIVITY potentiometer ❸ slowly counter clockwise until display shows zero. Stop. Turn the potentiometer slowly clockwise until display shows 10000.00. Stop.

12.5. Depress TRIGGER SELECTOR push-button ❻ and check that display shows zero.

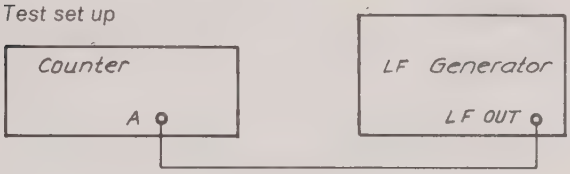
12.6. Depress TRIGGER SELECTOR push-button ❹ and check that display shows zero.

12.7. Pull SENSITIVITY switch ❸ turn it fully CW and check that display shows 10000.00.

12.8. Depress TRIGGER SELECTOR push-button ❻ and check that display shows 10000.00.

13. FREQUENCY A. Frequency response, sensitivity and sine wave trigger selector

Test set up



13.1. Set the controls of the counter:

FUNCTION ⓫	FREQUENCY 1 s
DISPLAY TIME ❶	Position ON
TRIGGER SELECTOR A ❼	depressed
SENSITIVITY A ❸	pulled, fully clockwise

13.2. Set the controls of the low frequency generator:

Amplitude:	20 mV
Frequency:	10 Hz
Signal mode:	sine wave

13.3. Check that display read-out is 0.010.

13.4. Slowly decrease the amplitude of the signal from the low frequency generator until display read-out becomes wrong. Stop. Slowly increase the amplitude just until display read-out becomes correct. Stop.

13.5. Check by means of an oscilloscope that the ampltude of the sgnal s less than 56 mV_{p-p}.

13.6. Set the frequency of the low frequency generator to 20 Hz and the amplitude to 20 mV.

13.7. Check that display read-out is 0.020 and repeat step 13.4.

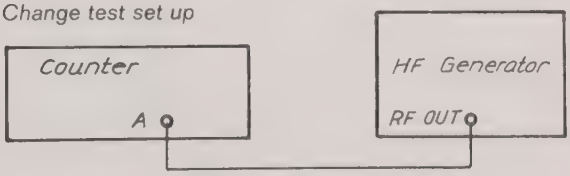
13.8. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}.

13.9. Set the frequency of the low frequency generator to 1 kHz and the amplitude to 20 mV.

13.10. Check that display read-out is 1.000 and repeat step 13.4.

13.11. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}.

Change test set up



13.12. Set the controls of the high frequency generator:

Frequency:	1 MHz
Amplitude:	20 mV
Signal mode:	sine wave

13.13. Check that display read-out is 10000.000 and repeat step 13.4.

13.14. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}.

13.15. Set the frequency of the high frequency generator to 80 MHz and the amplitude to 20 mV.

13.16. Check that display read-out is 80000.000 and repeat step 13.4.

13.17. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}

14. INPUT A. Low frequency filter and square wave trigger selectors

Test set up

14.1. Set the controls of the counter:

DISPLAY TIME A ❶	position ON
FUNCTION ⓫	FREQUENCY 1 s
LOW FREQUENCY FILTER ⓾	depressed
SENSITIVITY A ❸	pulled, fully clockwise

14.2. Set the controls of the low frequency generator:

Frequency:	100 kHz
Amplitude:	20 mV
Signal mode:	sine wave

14.3. Check that display read-out is 100.000.

14.4. Slowly decrease the amplitude of the signal from the low frequency generator until display read-out becomes wrong. Stop. Slowly increase the amplitude until display read-out becomes correct. Stop.

14.5. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}.

14.6. Set the frequency of the low frequency generator to 500 kHz and the amplitude to 50 mV.

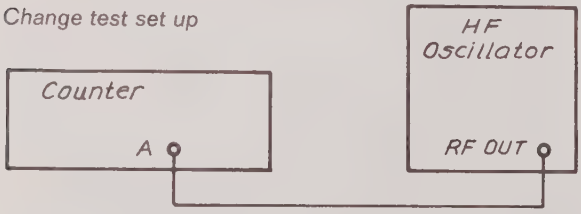
14.7. Check that the display read-out is 500.000 and repeat step 14.4.

14.8. Check by means of an oscilloscope that the amplitude is 50 to 110 mV_{p-p}.

14.9. Set the frequency of the low frequency generator to 5 MHz and the amplitude to 0.1 V.
Check that the display shows wrong read-out.

14.10. Increase the amplitude to 0.3 V and check that the display still shows wrong read-out.

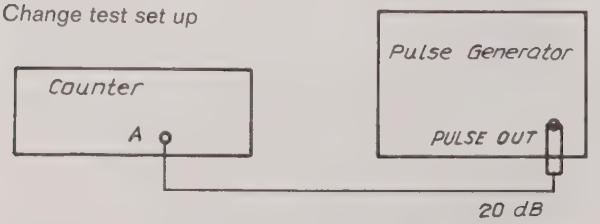
Change test set up



14.11. Set the frequency of the high frequency generator to 80 MHz and the amplitude to 1 V.
Check that the display shows wrong read-out.

14.12. Increase the amplitude to 2.4 V and check that the display still shows wrong read-out.

Change test set up



14.13. Depress TRIGGER SELECTOR ❻

14.14. Set the controls of the pulse generator:

Frequency:	5 MHz
Amplitude:	60 mV
Duration:	6 ns

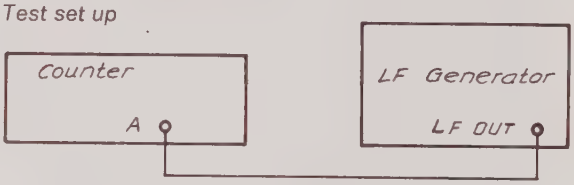
14.15. Check that the display read-out is 5000.000 and repeat step 14.4.

14.16. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}.

14.17. Depress TRIGGER SELECTOR ❹ and repeat steps 14.14 to 14.16 with inverted signal from the pulse generator.

15. INPUT A. Attenuator

Test set up



15.1. Set the controls of the counter:

DISPLAY TIME ❶	position ON
FUNCTION ⓫	1 s
TRIGGER SELECTOR ❼	depressed
SENSITIVITY ❸	pulled, fully clockwise

15.2. Set the controls of the low frequency generator:

Amplitude:	200 mV
Frequency:	1 kHz
Mode:	sine wave

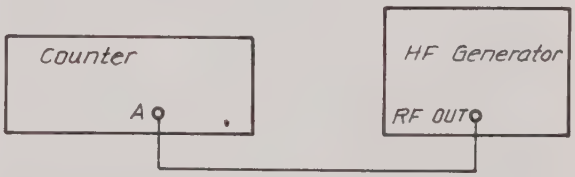
15.3. Check that display read-out is 1.000.

15.4. Turn SENSITIVITY potentiometer ❸ from fully clockwise to fully counter clockwise and check that display read-out is 1.000.

15.5. Slowly decrease the amplitude of the sine wave signal until the display shows wrong read-out. Stop. Slowly increase the amplitude until display read-out becomes 1.000. Stop.

15.6. Check the amplitude of the sine wave signal. Typical value is 150 mV.

Change test set up



15.7. Set the controls of the high frequency generator:

Amplitude:	200 mV
Frequency:	80 MHz
Signal mode:	sine wave

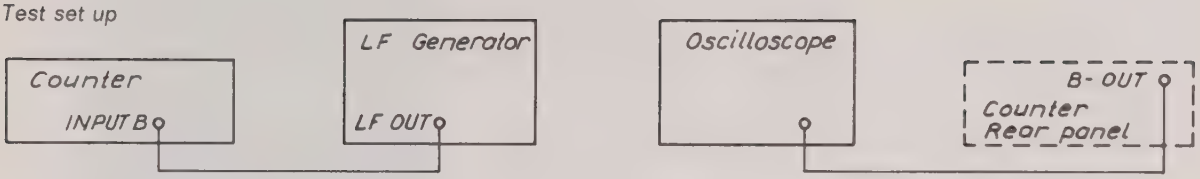
15.8. Check that display read-out is 80000.000.

15.9. Slowly decrease the amplitude of the sine wave signal until the display shows wrong read-out. Stop. Slowly increase the amplitude until display read out becomes 80000.000. Stop.

15.10. Check the amplitude of the sine wave signal. Typical valve is 150 mV.

16. B-OUTPUT

Test set up



16.1. Set the oscilloscope to 1 v/div and 50 ms/div.

16.2. Set the generator to sine wave mode, frequency 3 HMz and an amplitude of more than 20 mV.

16.3. Check that the oscilloscope displays a signal with waveform and amplitude similar to figure IX-2.

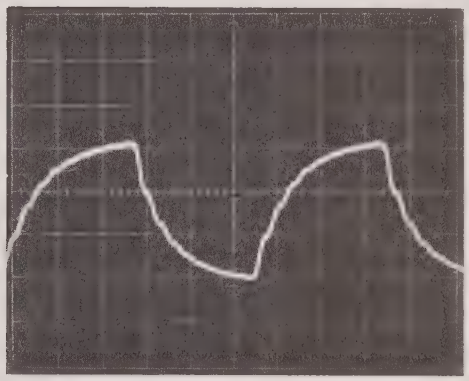


Fig. IX-2. B out

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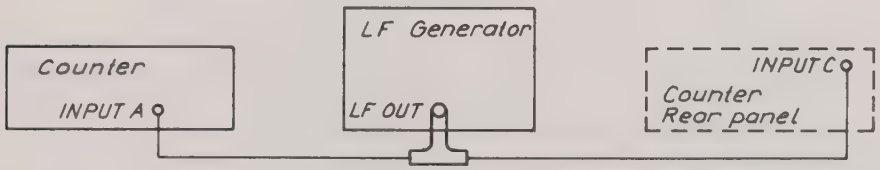
17. INPUT C. Frequency range and sensitivity

Test set up



17.1. Set the controls of the counter:

FUNCTION ⓫	FREQUENCY 1 s
SENSITIVITY ❸	pulled, fully clockwise
DISPLAY TIME ❶	position ON
TRIGGER SELECTOR ❼	depressed

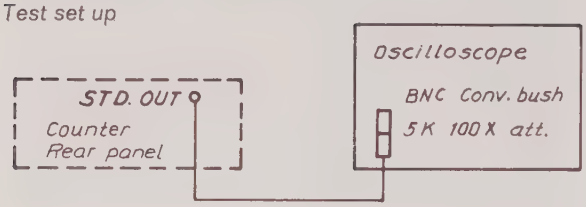
17.2. Set the frequency of the signal from the generator to 10 MHz and the amplitude to 600 mV.
Check that display shows 10000.000.

17.3. Slowly decrease the amplitude of the signal until display shows wrong read-out. Stop.
Slowly increase the amplitude until display shows correct read-out. Stop.

17.4. Check that the amplitude of the signal is less than 500 mV.

18. STD OUT

Test set up



18.1. Set the sampling oscilloscope to 10 mV/cm and 20 ns/cm.

18.2. Check that oscilloscope displays a signal with waveform and amplitude similar to figure IX-1.

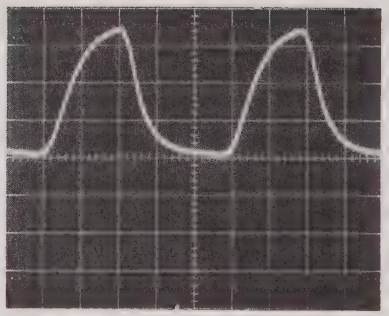


Figure IX-1. STD OUT signal, internal 10 MHz displayed.

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19. Temperature compensated crystal oscillator PM 9678

Test set up

19.1. This check requires a frequency standard having an accuracy of 1×10^{-7}.

The oven enclosed oscillators Philips PM 9680, PM 9681 and PM 9690 meet this requirement.
The check should preferably be made at an ambient temperature of +25° C.

19.2. Set the controls of the counter:

FUNCTION ⓫ FREQUENCY 10 s
TRIGGER SELECTOR ❼ depressed

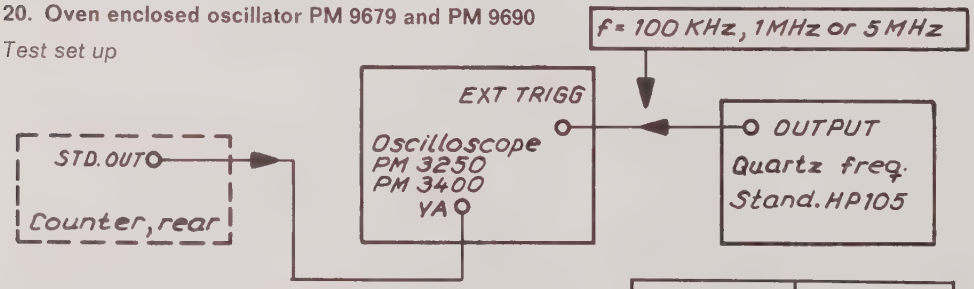
19.3. Check that the display shows 10000.0000 kHz ±1 Hz.

19.4. For adjustment instruction refer to chapter XI in the service manual.

---

20. Oven enclosed oscillator PM 9679 and PM 9690

Test set up



20.1. This check requires a frequency standard having an accuracy of 3×10^{-8} for PM 9679. The oven enclosed oscillators Philips PM 9680, PM 9681 and PM 9690 meet this requirement. For PM 9690 an accuracy of 1×10^{-9} is required. The quartz oscillator HP 105 meets this requirement.

CAUTION. The oscillator must have been operating continuously for at least 72 h before any check is made.

Waveform moves	*Oscillator frequency*
→	too low
←	too high

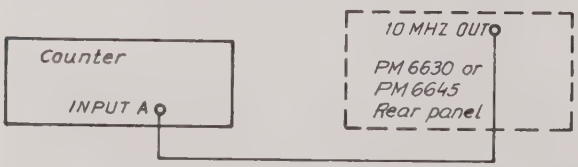
20.2. Observe the movement of the displayed waveform:

20.3. For adjustment instruction refer to chapter XI in the service manual.

---

21. Standard oscillator PM 9677

Test set up



21.1. This check requires a frequency standard having an accuracy of 1×10^{-6}. The oven enclosed oscillators Philips PM 9690, PM 9681 and PM 9690 meet this requirement. The check should preferably be made at an ambient temperature of +25° C.

21.2. Set the controls of the counter:

FUNCTION ⓫ FREQUENCY 1 s
TRIGGER SELECTOR ❼ depressed

21.3. Check that display shows 10000.000 kHz ±10 Hz.

21.4. For adjustment instruction refer to chapter XI in the service manual.

X. INTERNAL CHECKS AND ADJUSTMENTS

The tolerances mentioned in the following text apply to newly adjusted instruments only. The value may differ from those given in chapter II Technical Data.

Note: Always check the d.c. supply voltage before any adjustments are made!

1. Use figure XIII-2 to identify location of trimmers and check points.

2. Test equipment

Check point	*Instrument*	*Required data*	*Recommended model*
3	Voltmeter	5—150 V d.c.	Philips PM 2412
4 5	Oscilloscope	50 MHz bandwidth	Philips PM 3250
4 5	Probe	Passive 10 MΩ/11 pF	Philips PM 9336
4	LF generator	Frequency 10 kHz Amplitude 10 mV Signal mode sinewave	Philips PM 5145
5	Pulse generator	Frequency 10 kHz Amplitude 1 V Duty factor 0.5	Philips PM 5715 or PM 5705

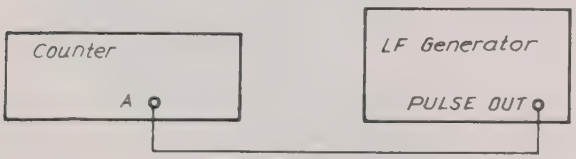
3. D.C. voltages

3.1. Connect voltmeter to jumper connector BU104 and check the d.c. voltages according to table below.

Testpoint	*Measured voltage*
+120	+115 to 130 V
+5.2	+4.8 to 5.2 V
+12	+11.5 to 13.0 V
—5.2	—5.2 to —6.0 V
—50	—50 to —60 V

4. D.C. balance channel A

Test set up



4.1. Set the controls of the counter:

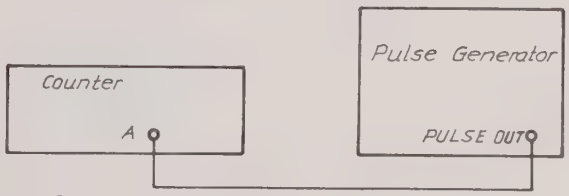
TRIGGER SELECTOR ❼ depressed
SENSITIVITY ❸ pulled, fully clockwise

4.2. Set the controls of the low-frequency generator:

Frequency : 1 kHz
Amplitude : 10 mV
Signal mode: Sine wave

4.3. Connect the oscilloscope via a well-adjusted 10 MΩ/11 pF probe to junction L101/R132.
Adjust R127 until displayed waveform has duty factor 0.5.

5. Frequency compensation channel A



5.1. Set the controls of the counter:

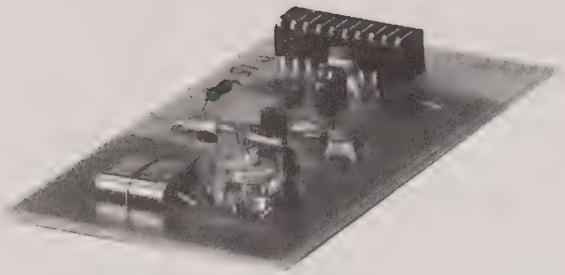
TRIGGER SELECTOR ❼ depressed

5.2. Set the controls of the pulse generator:

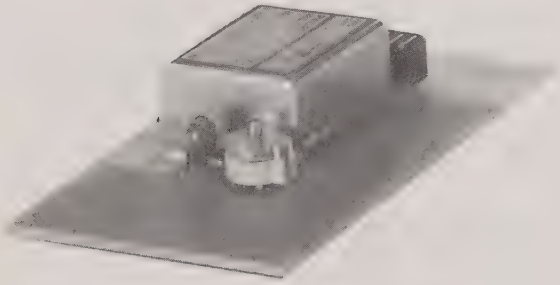
Frequency : 10 kHz
Amplitude : 1 V
Duty factor: 0.5

5.3. Connect the oscilloscope to L103 via a well-adjusted 10 MΩ/11 pF probe.
Adjust C102 to best square-wave symmetry of displayed waveform.

XI. OSCILLATORS PM 9677, PM 9678, PM 9679 and PM 9690



PM 9677
9446 096 770.1



PM 9678
9446 096 780.1

PM 9679
9446 096 790.1

PM 9690
9446 096 900.1

1. General

The oscillators are made as plug-in cards and have a nominal frequency of 10 MHz.

2. Technical data

2.1. Electrical	*PM 9677*	*PM 9678*	*PM 9679*	*PM 9690*
Nominal frequency, MHz	10.000 000	10.000 000	10.000 000	10.000 000
Trimming range, Hz	> ± 200	> ± 20	+20*) —30	+3*) —7
Output voltage, mV (into 1 kohm)	> 300	> 100	> 150	> 50
Supply voltage, V	+ 12	+ 12	+ 11.5 to 28 (from unregulated power supply)	+ 11.5 to 28 (from unregulated power supply)
Power consumption (+25°C)				
Continuous operation	< 100 mW	< 200 mW	< 100 mA	< 125 mA
Stand by	none	none	< 100 mA	< 125 mA
Warm up	none	none	< 400 mA	< 400 mA
Stability against:				
Ageing	$< 5\times10^{-7}$/month	$< 1\times10^{-7}$/month**)	$< 1\times10^{-7}$/month	$< 1.5\times10^{-9}$/24 h (after 72 hours of continuous operation)
Temperature 0 . . . 50°C (ref. to +25°C)	$< 1\times10^{-5}$	$< 1\times10^{-6}$	$< 1\times10^{-7}$	$< 3\times10^{-8}$
Line voltage ± 10 %	$< 1\times10^{-8}$	$< 1\times10^{-9}$	$< 1\times10^{-9}$	$< 5\times10^{-10}$
Change of measuring mode and change between line, ext. and int. battery	$< 3\times10^{-7}$	$< 5\times10^{-8}$	$< 1\times10^{-8}$	$<3\times10^{-9}$
Warm up time (to reach 1×10^{-7})			< 10 min	< 15 min

2.2. Environmental				
Temperature				
Storage, °C	—40 to +70	—40 to +70	—40 to +70	—40 to +70
Operating, °C	0 to +50	0 to +50	0 to +50	0 to +50
Altitude				
Storage, m	15000	15000	15000	15000
Operating, m	5000	5000	5000	5000
Humidity at 50°C	10—90 % RH (26° dew point)	10—90 % RH (26° dew point)	10—90 % RH (26° dew point)	10—90 % (26° dew point)
Shock	Meets the requirement of the IEC Eb recommendations } all oscillators			
Vibration	Meets the requirement of the IEC 68F recommendations }			

2.3. Mechanical				
Dimensions, mm	93×50×20	93×50×15	100×52×35	100×52×35
Weight, g	50	25	100	100

*) The indicated values regard only the fine trimming range. A coarse trimmer is available on the PM 9679 and PM 9690 to adjust for an ageing of more than 10 years.

**) Trimming range will cover at least 10 years of operation since the ageing will decrease substantially after the first 6 months.

3. Frequency adjustment PM 9677

3.1. This adjustment requires a reference oscillator having an accuracy of $\leq 1 \times 10^{-6}$.
The oven enclosed PHILIPS oscillators PM 9680*, PM 9681* and PM 9690* meet this requirement.
The adjustment should preferably be made at an ambient temperature of +25°C.
3.2. Remove the bottom cover of the counter.
3.3. Connect the reference signal available at socket 10 MHz OUT of the external counter to INPUT A of the counter to be adjusted.
3.4. Set the controls of the counter to be adjusted:
FUNCTION SELECTOR ⓫: FREQUENCY 1 Hz (1s)
TRIGGER SELECTOR ❼ : depressed
3.5. Adjust trimming capacitor C 1 to 10000.000 kHz plus or minus 10 Hz.

4. Frequency adjustment PM 9678

4.1. This adjustment requires a reference oscillator having an accuracy of $\leq 1 \times 10^{-7}$.
The oven enclosed PHILIPS oscillator PM 9680*, PM 9681* and PM 9690* meet this requirement.
The adjustment should preferably be made at an ambient temperature of +25°C.
4.2. Remove the bottom cover of the counter.
4.3. Connect the reference signal available at socket 10 MHz OUT of the external counter to INPUT A of the counter to be adjusted.
4.4. Set the controls of the counter to be adjusted:
FUNCTION SELECTOR ⓫: FREQUENCY 1 Hz (1s)
TRIGGER SELECTOR ❼ : depressed.
4.5. Adjust trimming capacitor C 1 to 10000.000 kHz plus or minus 1 Hz.
4.6. Set FUNCTION SELECTOR ⓫ to position 0.1 Hz (10s) and check that display read-out is the same as before. If not, adjust C 1 slightly to correct frequency.

5. Frequency adjustment PM 9679

5.1. This adjustment requires a reference oscillator having an accuracy of $\leq 3 \times 10^{-8}$.
The oven enclosed PHILIPS oscillators PM 9680*, PM 9681* and PM 9690* meet this requirement.
The adjustment should preferably be made at an ambient temperature of 25°C and the oscillator must have been operating continuously 72 h before any adjustment is made.
5.2. Remove the bottom cover of the counter.
5.3. Connect the reference signal available at socket 10 MHz OUT of the external counter to socket EXT. TRIGG of oscilloscope PHILIPS PM 3250 or PM 3400.
5.4. Connect the oscillator signal available at socket 10 MHz OUT of the counter to be adjusted to INPUT A of the oscilloscope.
5.5. Set oscilloscope to 100 ns/div and adjust trimming potentiometer R 208 until waveform moves with a velocity of maximum 1 div./3 s (0.3 Hz).
If the adjustment range of R 208 is too narrow perform the following steps 5.6 to 5.12.
5.6. Set trimming potentiometer R 208 to fully clockwise position.
5.7. Remove the two screws fixing the oscillator's text plate to the box.
5.8. Remove the small plastic cylinder beneath the text plate using a pair of tweezers.
5.9. Connect an external counter to socket 10 MHz OUT at the rear panel of the counter to be adjusted.
5.10. Adjust trimming capacitor C 108 until the display read out of the external counter is 10000020 Hz.
5.11. Refit the plastic cylinder and the text plate.
5.12. Perform steps 5.3 to 5.5.

6. Frequency adjustment PM 9690

6.1. This adjustment requires a reference frequency having an accuracy of $\leq 1 \times 10^{-9}$.
Hewlett-Packard quartz frequency standard HP 105* meets this requirement.
The adjustment should preferably be made at an ambient temperature of 25°C and the oscillator must have been operating continuously 72 h before any adjustment is made.
6.2. Remove the bottom cover of the counter.
6.3. Connect any of the three reference signals available at sockets 5 MHz, 1 MHz and 100 kHz of the HP 105 to socket EXT. TRIGG of oscilloscope PHILIPS PM 3250 or PM 3400.
6.4. Connect the oscillator signal available at socket 10 MHz OUT of the counter to be adjusted to INPUT A of the oscilloscope.
6.5. Set oscilloscope to 100 ns/div and adjust trimming potentiometer R 208 until waveform moves with a velocity of maximum 1 div/10 s (0.1 Hz).
If the adjustment range of R 208 is too narrow perform the following steps 6.6 to 6.12.
6.6. Set trimming potentiometer R 208 to fully clockwise position.
6.7. Remove the two screws fixing the oscillator's text plate to the box.
6.8. Remove the small plastic cylinder beneath the text plate using a pair of tweezers.
6.9. Connect an external counter to socket 10 MHz OUT at the rear panel of the counter to be adjusted.
6.10. Adjust trimming capacitor C 108 until the display read out of the external counter is 10000003 Hz.
6.11. Refit the plastic cylinder and the text plate.
6.12. Perform steps 6.3 to 6.5.

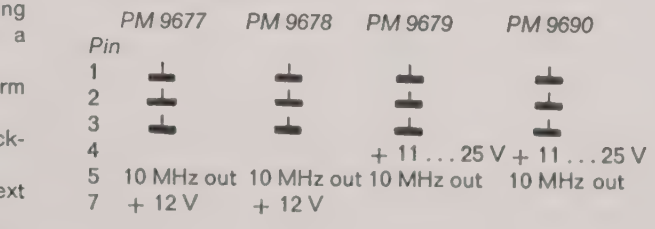
7. Repair of oscillator PM 9679 and PM 9690

7.1. Repair of these oscillators may not be carried out by the local service organisations. In case of breakdown the complete sealed oscillator box has to be sent to the factory for repair.

Factory address:

PHILIPS ELEKTRONIKINDUSTRIER AB
INDUSTRIAL OPERATIONS
FACK
S-175 20 JÄRFÄLLA
SWEDEN

8. Pin configuration



*To be checked against a frequency standard such as Droitwich or HBG.

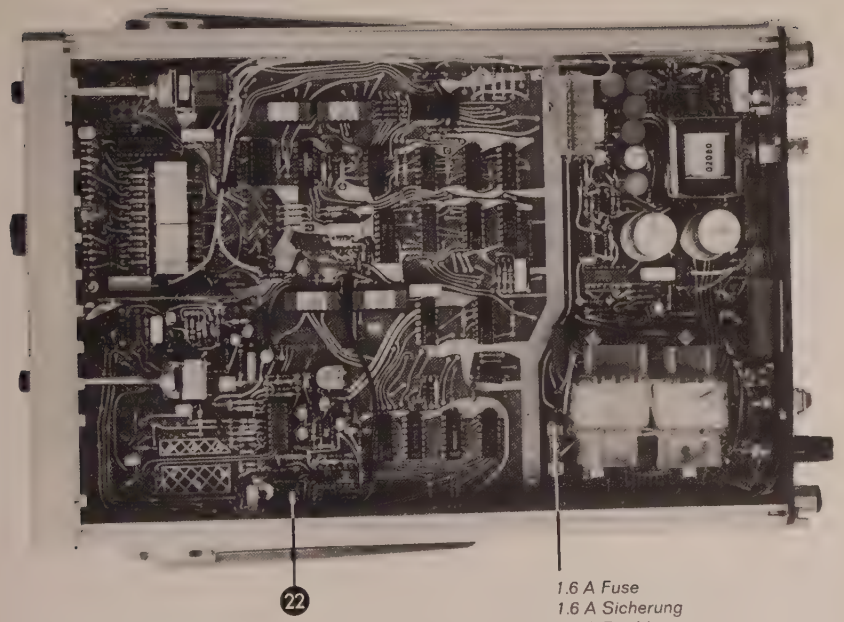


Figure VI-3. Top view
Abbildung VI-3. Ansicht von oben
Figure VI-3. Vue dessus

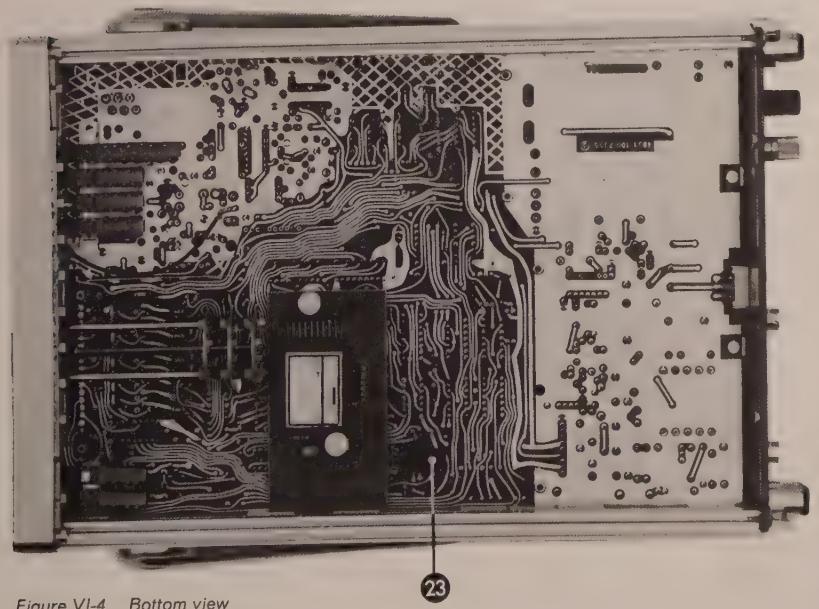


Figure VI-4. Bottom view
Abbiddung VI-4. Unteransicht
Figure VI-4. Vue dessous

Service manual

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VII. SURVEY OF CONNECTORS, SOCKETS, SWITCHES AND POTENTIOMETERS

BU 1	Input socket channel A
BU 2	Input socket channel B
BU 21	Input socket plus pole external battery
BU 22	Input socket minus pole external battery
BU 23	Mains input socket
BU 24	Input socket channel C
BU 25	Output socket, internal or external oscillator
BU 26	Earth clamp
BU 27	B OUT
BU 103	Connects oscillator to unit U1. Male
BU 104	Jumper connector for d.c. voltages. Male
BU 105	Connector for internal battery. Male
BU 106	Connector for BCD and D/A converter. Female
BU 107	Connector for d.c. voltages. Female
SK 22	EXTERNAL/INTERNAL STANDARD switch
SK 101	DISPLAY TIME switch
SK 102	STAND BY switch
SK 103	RESET switch
SK 104	MEMORY and START/STOP switch
SK 105	FUNCTION selector switch
SK 106	SENSITIVITY switch channel A
SK 107	LOW FREQUENCY FILTER switch channel A
SK 108	SINE WAVE triggering switch channel A
SK 109	POSITIVE PULSE triggering switch channel A
SK 110	NEGATIVE PULSE triggering switch channel A
SK 111	SINE WAVE triggering switch channel B
SK 112	POSITIVE PULSE triggering switch channel B
SK 113	NEGATIVE PULSE triggering switch channel B
SK 121	INTERNAL BATTERY/MAINS OR EXTERNAL BATTERY switch
SK 131	Jumper connector for EXTERNAL/INTERNAL STANDARD (only present in earlier version of the instrument)
R 107	SENSITIVITY potentiometer channel A
R 146	SENSITIVITY potentiometer channel B
R 1157	DISPLAY TIME potentiometer

VIII. CIRCUIT DESCRIPTION

1. 80 MHz input amplifier, channel A

Refer to the circuit diagram fig. XIII-3.

The measuring signal enters the amplifier at BNC socket INPUT A. The DC component of the signal is blocked by C 101. A two-position attenuator R 101, R 137, C 102, C 103 is controlled by switch SK 106. C 102 sets the frequency compensation.

Input protection is provided by R 102, C 104, R 103 and clipping diodes GR 101, 102, 103 and 106. Field-effect transistor TS 101 converts the input impedance together with emitter-follower TS 102 providing a low-ohmic output to the amplifier circuits. R 111, L 103 and C 132 form a 100 kHz low-pass filter which is operated with switch SK 107. R 107 sets the input sensitivity. When SK 107 is released, SK 108 has no function.

However, when both switches are depressed at the same time, the time base reference signal from IC 123:8 (see circuit diagram Time Base Dividers) is applied to the amplifier section via R 110, R 124, SK 107:3, 2 and SK 108:6, 5.

Switches SK 110 and SK 109 are principally polarity shifters selecting the normal (10) or inverting (9) input of line receiver IC 101.

When the input signal is a sine wave or pulses with the duty factor 25 to 75 %, both SK 110 and SK 109 should be released. The signal path is then from SK 108 through C 117, pins 8 and 7 of SK 110, and R 116 to the non-inverting input 10 of the first amplifier IC 101. The signal is available at both outputs 7 and 6.

When the input signal is a pulse train with a duty factor exceeding 75 %, switch SK 110 should be depressed. The signal now goes through pins 8 and 9 of SK 110 and via R 115 to the inverting input 9 of IC 101. The dc reference level is shifted outside the triggering window of the amplifier because pins 2 and 3 of SK 110 are connecting R 112 to earth.

SK 109 should be depressed when the input signal is a pulse train with duty factor below 25 %. Notice that SK 109 and SK 110 are interacting, so that SK 110 is automatically released when SK 109 is depressed. The signal path is now via C 117, pins 8 and 7 of SK 110. and R 116 to input 10 of IC 101. The only active function of SK 109 is to connect R 112 to earth to set the dc reference level of IC 101 outside the trigger window. Symmetrical feedback of the first amplifier stage IC 101 is provided by R 113 and R 114. At outputs 7 and 6, R 118 and R 119 are pull-down resistors for the emitter follower outputs.

The next amplifier stage of IC 101 with inputs 4 and 5 is not symmetrically fed back to prevent interference from Schmitt trigger TS 104, TS 103, from reaching the amplifier.

Output 3 provides the signal for Schmitt trigger TS 104, TS 103. GR 110 ensures temperature stabilisation. TS 105 is interfacing the Schmitt trigger output to TTL level. Before the choke L 101 at the collector of TS 105, the signal A 1 is taken out to the DCU. L 101 is filtering frequencies above 10 MHz. Output signal A 2 is used as the time base signal in the PERIOD mode.

2. 10 MHz input amplifier, channel B

Refer to the circuit diagram fig. XIII-3.

The measuring signal enters the input amplifier at input socket B. The DC component of the signal is blocked by C 113.

C 114 permits the higher frequencies to reach the clipping diodes GR 104 and GR 105.

Field effect transistor TS 106 provides impedance conversion. The gate and source signals having opposite polarity are fed to switch SK 113.

All switches SK 113, SK 112 and SK 111 are interacting, which means that the only function of SK 112 is to release SK 113 or SK 111.

When SK 113 is depressed, the drain of FET TS 106 is earthed via C 115 and SK 113:6, 5.

The signal from the source of TS 106 is fed via SK 113:3, 2 and variable resistor R 146, SENSITIVITY to the time base divider input B2.

When SK 113 is released, i.e. if either SK 112 or SK 111 is depressed, the signal with opposite polarity is fed from the drain of TS 106 via C 115, SK 113:1, 2 and to input B2 of the time base divider.

When SK 111 is released, a —5.2 V voltage is applied to B1 of the time base divider.

With SK 111 in depressed position, B2 is open.

3. Time base divider

3.1. General (Se circuit diagram fig. XIII-4)

A dual line receiver IC 120 is used to transfer the internal or external time base reference signal to the time base divider section.
The line receiver consists of two identical stages, each with a differential amplifier converting the input signal into appropriate TTL level, and a NAND gate controlled by the INT/EXT STD switch SK 22 and the Function switch SK 105.
In the FREQUENCY A mode using the internal oscillator, the 10 MHz signal from BU 103:5 is fed to input 2 of IC 120 via amplifier IC 102 and SK 22:1, 2. Next, the signal is fed to the NAND gate of IC 120. This gate is enabled by HIGH levels applied to control inputs 5 and 6 except in the RATIO mode, in which the gate is inhibited by a LOW level at pin 5.
From output IC 120:4 the 10 MHz signal is applied to input 9 of NAND gate IC 123. The second input 10 of this gate is HIGH in the FREQ mode. Rear output BU 25, STD OUT provides the 10 MHz signal for external use.
When an external time base is used, the signal applied to BU 24, INPUT C, is fed via SK 22, set to the EXT position, to input IC 120:2.
Via R 156 and R 152, the signal is fed to rear output BU 25, STD OUT.
Similar to the INT.STD mode, the external time base signal will be available at output IC 120:4, and fed to input 9 of the NAND gate IC 123.
Either the internal 10 MHz or the INPUT C signal is fed to input 4 og the AND/NOR configuration IC 121.
A time base reference signal is tapped off to the main gate (See circuit diagram "Decimal Counting Unit").
Control input 5 of IC 121 is HIGH in all modes except PERIOD A. In this mode, input IC 121:2 is HIGH, so that the A signal applied to input 3 can pass through. In the FREQUENCY mode, however, the gate IC 121:4, 5, is enabled and the signal can pass through via IC 121:6, IC 122:11, and R 134 to the time base dividers consisting of two LOCMOS quad decade counters IC 124 and IC 125.
The function of these circuits is described under section 4, Decimal Counting Unit.
The division factor is set with the Function switch SK 105 which controls the Decade Select inputs indicated M0, M1 and the Enable inputs as illustrated in the table below.
The divided signal corresponds to the D bit of the relevant decade counter and is available at terminal 18 of each circuit IC 124 or IC 125. Via transistor TS 120 it is fed to the AND-NOR configuration IC 121, input 13.
The second input 1 of IC 121 is HIGH in all modes except PERIOD A n = 1 and TIME INTERVAL "μs". In these modes input IC 121:10 is HIGH allowing the signal from IC 121:6 to pass through via IC 121:9 to output 8.
Next, the time base signal is gated through NOR gate IC 126:5. Input IC 126:6 is LOW except in the TIME INTERVAL mode. In all other modes, the signal passes through and is fed to input 10 of NAND IC 127 via inverter IC 126:1.
Output IC 127:8 controls clock input 3 of the main gate flip-flop IC 183. Its output 6 controls the main gate, whereas output 5 controls the gate indicator LED GR 189 via monostable multivibrator IC 182 and transistor TS 170. The second flip-flop of IC 183 is clocked at input 11 by the main gate flip-flop and is used as the display time flip-flop.

MODE	ENABLE IC 124	ENABLE IC 125	DECADE SELECT INPUTS			SELECT DECADE OF	
			M 0	M1 IC 124	M1 IC 125	IC 124	IC 125
RATIO A/B n = 10^4	H	L	H	H	L	D4	
RATIO A/B N = 10^2	H	L	H	L	L	D2	
COUNT A	H	L	H	L	L	D2	
FREQ. A 0.1 s	L	H	H	L	L		D2
FREQ. A 1 s	L	H	L	L	H		D3
FREQ. A 10 s	L	H	H	L	H		D4
PERIOD A n = 1	L	H	H	L	H		D4
PERIOD A n = 10^2	H	L	H	L	H	D2	
PERIOD A n = 10^4	H	L	H	H	L	D4	
T.I. A-B ms	H	L	L	H	L	D3	
T.I. A-B μs	H	L	L	H	L	D3	

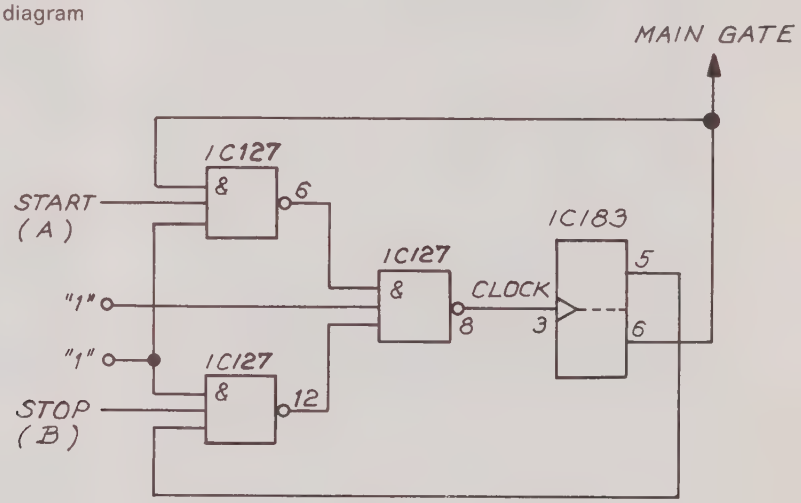
H = HIGH level, L = LOW level.

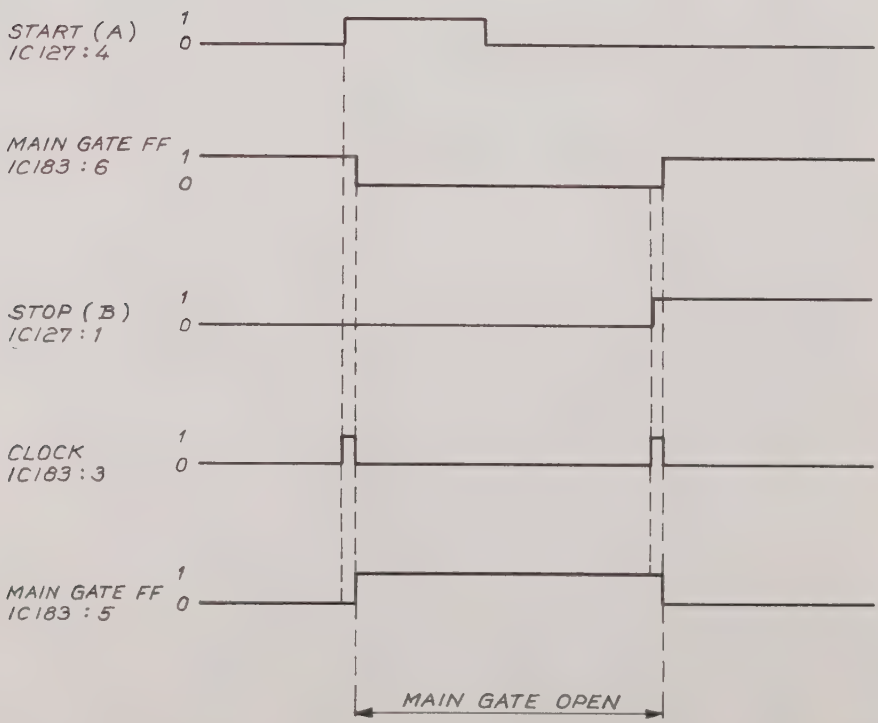
3.2. Time Interval mode

In this mode the signals from the A and B inputs are used as start and stop signals controlling the opening and closing of the main gate.
The start signal from input channel A is indicated A2 in the circuit diagram. It is fed via inverter IC 126:11, 13 to the start/stop gating network IC 127.
The stop signal from input channel B is indicated B2 in the circuit diagram.
Input B is either —5.2 V or open depending on the polarity chosen with SK 111, SK 112 or SK 113.
This control signal is used to bias the line receiver IC 101.
The measuring signal B2 passes IC 101 to the line receiver IC 120, input 12. This section of IC 120 is connected as a Schmitt trigger.
Output 9 provides the shaped signal partly to rear output B OUT, BU 27, via R 139, and partly to the start/stop gating network IC 127.
The function of the gating network and the main gate flip-flop IC 183 appears from the simplified diagram and the timing diagram illustrated below.

3.3. Ratio A/B

In this mode the higher frequency applied to input A is counted during an interval determined by the lower frequency applied to input B.
This means that the internal or external time base reference is disconnected. By setting the Function switch SK 105 to RATIO, pin 6 of wafer 3 is disconnected from the earthed pin 3.
Inputs 4 and 5 of NAND IC 122 go HIGH, and a LOW level is applied to input 5 of IC 120.
Consequently the oscillator signal path is inhibited. Simultaneously, input 2 of NAND IC 123 goes HIGH, allowing the B signal to pass on to input 10 of IC 123, and further to IC 121:4.
Next, the signal path goes to the time base divider IC 124 as described in section 3.1.





3.4 Synchronized preset

Refer to the simplified diagram fig. VIII-1.

During the display time interval, the time base dividers are preset to 9999. When the display time interval is ended and the RESET signal goes HIGH, the next clock pulse will trigger the decade counters of the time base dividers. Randomly, the display time interval may end during a clock pulse which might imply uncertain triggering of the dividers. To prevent this, the preset function is synchronized to the leading edge of he clock pulse.

The circuit achieving this consists of NAND gates IC 123 forming a latch configuration and NAND gate IC 122 with output terminal 3. The CLOCK signal applied to IC 122:12, 13 is also fed to IC 123:12. The RESET signal is applied to inputs IC 123:5 and IC 122:2. This means that the latch is controlled by the RESET signal. For example, when the RESET signal is LOW, output IC 122:3 providing the PRESET signal to IC 124:12 is HIGH, independent of the state of the CLOCK signal.

However, output IC 122:3 PRESET, goes LOW only when both inputs 1 and 2 go HIGH. This means, that when RESET goes HIGH during the time the CLOCK signal is also HIGH, input IC 122:1 is still LOW and the PRESET signal at IC 122:3 HIGH. But when the CLOCK signal goes LOW, the PRESET signal will be LOW.

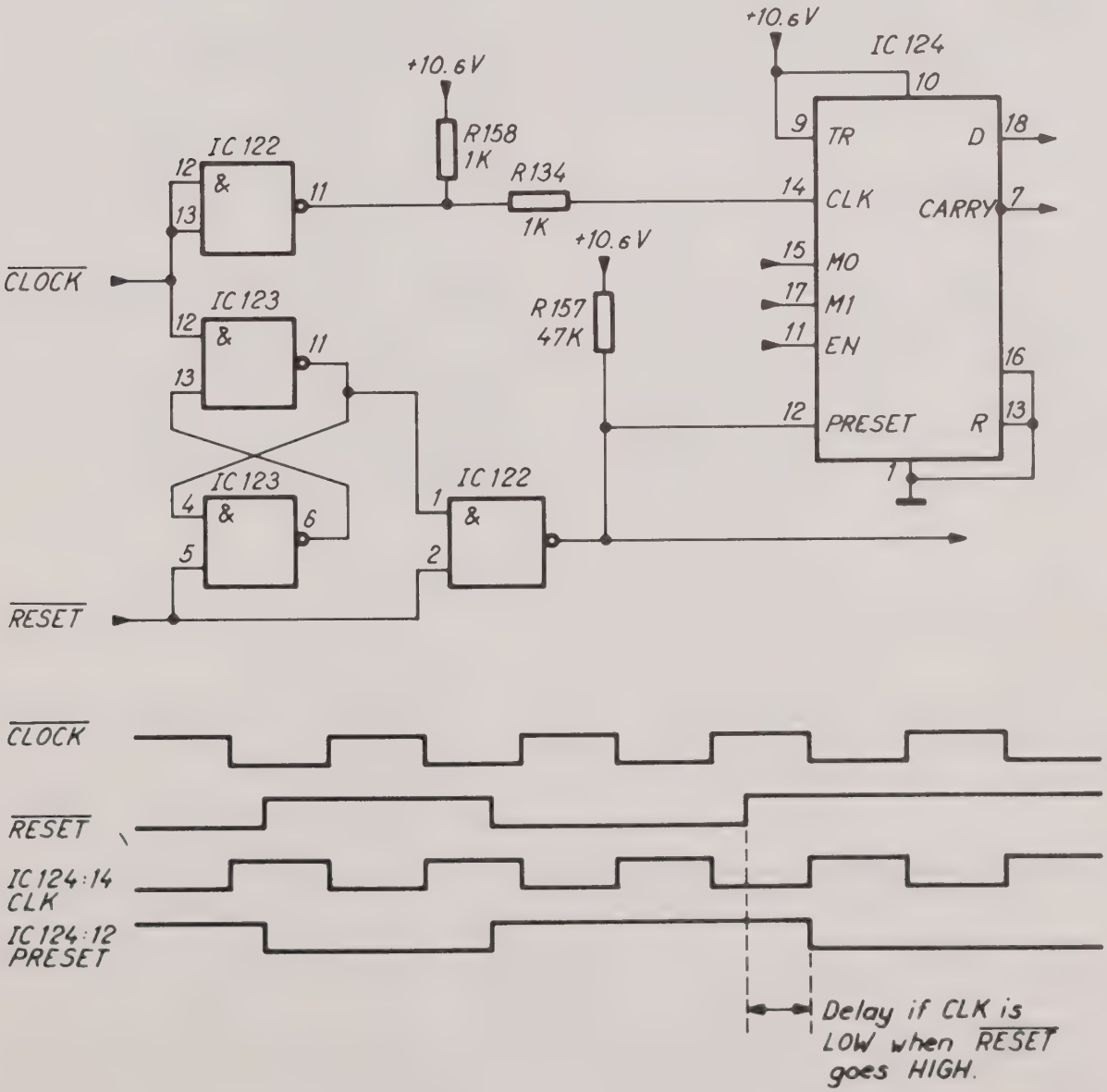


Fig. VIII-1. Preset sync circuit

3.5. Main gate and display time control

IC 183 is a dual D-flip-flop, containing the Main Gate FF and the Display FF. Both flip-flops are triggered by the positive going edge of their clock signal.
In all operating modes except COUNT A, a time base signal is applied to the clock input 3 of the Main Gate FF. The complementary output Q, pin 6, is connected to the main gate in the DCU section. The main gate is closed when Q is HIGH, but will open when Q goes LOW.
Assume that Q, pin 6, is HIGH. Then the D input pin 2 is also HIGH. At the next positive-going edge of the time base signal, output Q goes LOW and the main gate opens, i.e. the counting interval starts. The second output IC 183:5, Q, controls the Gate LED Multivibrator via input 13 of NOR gate IC 182. This monostable multivibrator controls the Gate LED GR 189 via TS 170. The LED can also be turned on by the front panel DISPLAY TIME switch when set to the STAND BY position. The monostable multivibrator is stretching the pulse at the shortest gate time settings so that the blinking of the LED becomes visible.
At the next positive-going edge of the clock signal at IC 183:3, the Main Gate flip-flop switches over, the complementary output IC 183:6 goes HIGH and the main gate is closed.
At this moment the display time interval starts. During this interval a TRANSFER pulse should be generated to the decade counters in the decimal counting unit, and a RESET pulse should be generated before the next counting interval starts.
The timing diagram fig. VIII-2 shows the sequence of these events. The Display Time flip-flop IC 183 is triggered by the positive-going edge of the MAIN-GATE signal from IC 183:6. Output IC 183:9 goes HIGH and provides a LOW CLEAR pulse to the Main Gate flip-flop input 1 via NOR gate IC 184:10. The output state of the Main Gate flip-flop is then maintained. The complementary output IC 183:8 of the Display Time flip-flop is LOW which normally would have set NOR gate output IC 185:10 to a HIGH level, causing the generation of a TRANSFER pulse via C 173 and R 1156. However, an INHIBIT LOW signal is assumed to be applied (e.g. from an automatic measuring system) via BU 106:5. Via IC 185:2 and 9, output 10 is latched to a LOW level until the INHIBIT signal goes HIGH. Then IC 185:10 goes HIGH and is latched to this state by the feed-back to input 3 eliminating the influence of another INHIBIT LOW signal that may appear. The positive-going edge is differentiated by C 173—R 1156, and a TRANSFER pulse is generated and fed to the DCU via IC 184:6. The positive-going edge from IC 185:10 is also fed to the Display Time multivibrator input IC 182:6 via R 1156. Capacitator C 172 starts charging and at the threshold level of IC 182:6, the multivibrator is triggered. Output IC 177:10 generates a sloping pulse which is converted to a proper RESET pulse at NOR gate output IC 178:13. Inverter IC 178:1 provides the RESET pulse to the DCU.

The RESET pulse is resetting the Time Base Dividers IC 124 and IC 125 via NAND gate IC 122, output 3. The Display Time flip-flop IC 183 is cleared by the RESET pulse at input 13, i.e. output IC 183:9 goes LOW. When the RESET pulse ends, the time base dividers generate clock pulses for the Main Gate flip-flop and the cycle is repeated. However, as illustrated in the second sequence of the timing diagram fig. VIII-2, the TRANSFER pulse appears immediately when the main gate is closing.

A third alternative occurs when the MEMORY push-button switch SK 104 is depressed, i.e. the memory is switched off. Then the main gate flip-flop output IC 183:6 is directly connected via pins 3 and 2 of SK 104 to input 5 of NAND gate IC 184. The TRANSFER pulse will then coincide with the main gate pulse plus the additional short pulse at the beginning of display time interval. Manual RESET is generated by push-button SK 103. Latch configuration IC 184:3 and 11 prevents contact bounce interference.

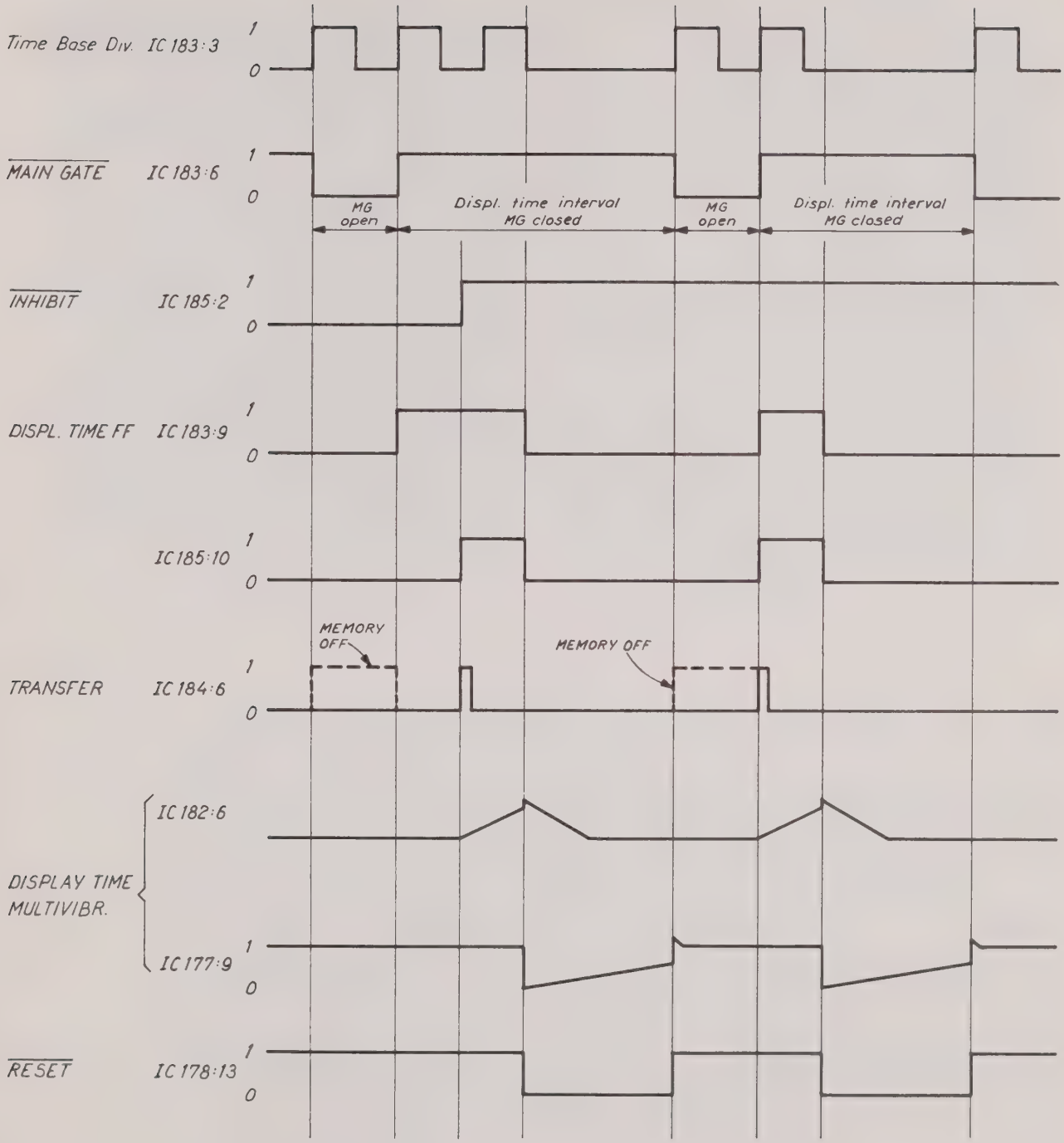


Fig. VIII-2. Timing diagram, main gate and display time control

4. Decimal counting unit—DCU—and display unit

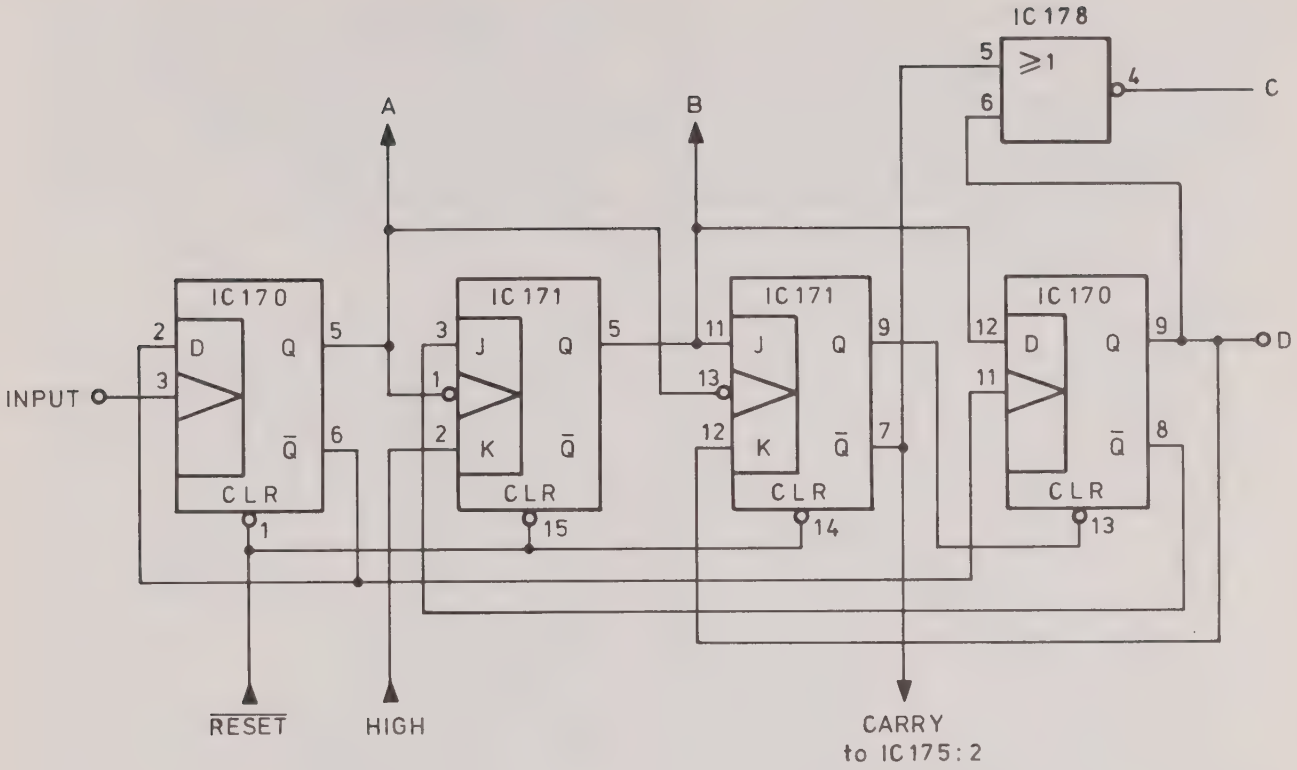
4.1. General

Refer to the circuit diagram fig. XIII-5.
The DCU consists of an 80 MHz decade IC 170, IC 171 for the least significant digit and two LOCMOS circuits IC 175, IC 176 each containing four complete decades. An address counter IC 179 generates the ENABLE signals for the 80 MHz decade the quad decades IC 175, IC 176 and also the scanning pulse sequence for the display via a BCD to 1 of 10 decoder IC 180.
The four-line BCD code provided by the decades is applied to the display via a BCD to 7 segment decoder IC 181. The outputs of this circuit are connected each to one segment of the 9 parallel connected digits including the decimal point.

4.2. 80 MHz decade

Refer to the circuit diagram fig. XIII-5 and the timing diagram fig. VIII-3.
2 D-type flip-flops IC 170, two edge-triggered JK flip-flops and a decoder NOR gate IC 178 form the 80 MHz decade. The input signal comes from the main gate IC 172 and triggers the first D flip-flop IC 170 which generates the A bit of the four-line BCD code. Next, the flip-flop IC 171 generates the B bit. When triggered by the negative edge of the A signal and the JK inputs are HIGH, i.e. when the complementary D bit at input J is HIGH. The K input is permanently HIGH.
The third flip-flop in the row, also a JK IC 171, produces the CARRY signal when triggered by the negative edge of the A pulse and the output of this flip-flop changes according to the state of the JK inputs at the time of triggering.
The fourth flip-flop, a D-type IC 170, produce the D bit at IC 170:9 when triggered by the complementary A bit assuming the B bit applied to the Data input IC 170:12 is HIGH.

Both the CARRY and D signals are applied to NOR gate decoder 1/4 IC 178 which generates the C bit as indicated in the timing diagram fig. VIII-3.
The four-line BCD information from the 80 MHz decade is then stored in the latch flip-flop IC 173. When the gate time ends, a TRANSFER pulse enables the latch which supplies the BCD data to the NAND gate network IC 174. These gates are inhibited until the ENABLE signal — D = HIGH — arrives from the address counter IC 179. When enabled, the BCD information are transferred via the data bus line to the BCD to 7 segment decoder IC 181. Refer to the timing diagram fig. VIII-4.



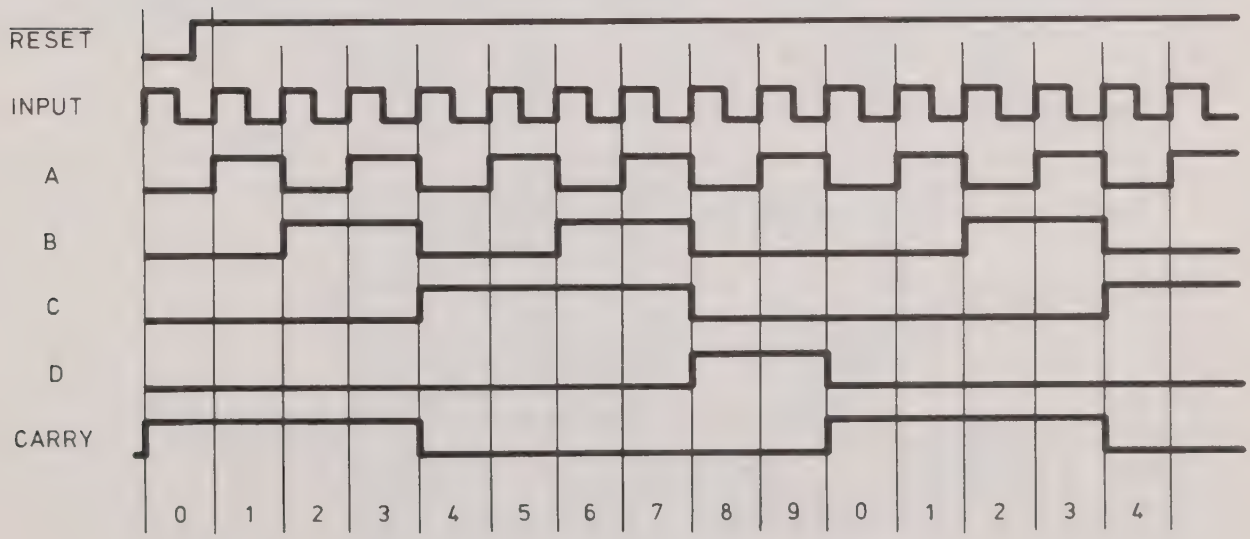


Fig. VIII-3. 80 MHz decade circuit and timing diagram

4.3. LOCMOS quad decades IC 175, IC 176

The CARRY signal from the 80 MHz decade is also used to clock the first decade counter of the LOCMOS circuit IC 175. This decade is referred to as D1 in the timing diagram fig. VIII-4.
DO indicates the 80 MHz decade just described. Each of the four decades contained in the LOCMOS circuit IC 175 or IC 176 functions principally as the 80 MHz decade. However, a brief look at the block diagram fig. VIII-5 will help understanding the special features. The PRESET input is permanently LOW and inactive because it is connected to—2.1 V. The CLOCK signal enters at input 14 and triggers the decades whose outputs are stored in the corresponding latches. When the TRANSFER pulse arrives, the information is fed to the multiplexer. Depending on the states of the Digit Select Inputs M0, M1, M2, the data of one of the decades is transferred to the BCD outputs provided the ENABLE input is HIGH. The truth table in figure VIII-5 indicates the relevant input states. Inputs M0 and M1 are addressed with BCD bits A and B respectively from the Address Counter IC 179. Input M2 is connected to—2.1 V and thus permanently LOW. The ENABLE signal to the first quad decade IC 175 is generated by NOR gate 1/4 IC 182 whose inputs are the C and D bits of the Address Counter IC 179. Thus, when both C and D are LOW as indicated in the timing diagram fig. VIII-4 the ENABLE signal to IC 175 goes HIGH. Assuming that both A and B of the Address Counter are LOW, decade D1 will provide its information to the BCD output and further to the BCD to 7-segment decoder IC 181. In the example given in the timing diagram fig. VIII-4 the digit next to the LSD will display a "2".
The next address from IC 179 will be A = HIGH, which means that the data of decade D2 is transferred to the BCD outputs and digit "0" is displayed. The sequence goes on until decade D4 has been selected. Then the ENABLE signal of IC 175 goes LOW because the C bit of the Address Counter goes HIGH. Instead, the ENABLE signal for quad decade IC 176 goes HIGH. Now the sequence starts again with the Digit Select Inputs M0, M1, M2 all being LOW thus selecting decade D5. Finally, decade D8 is selected corresponding to the Most Significant Digit, MSD.

4.4. Blanking

As indicated in the timing diagram fig. VIII-4, the output signals from the BCD to 7-segment decoder IC 181 contain blanking pulses between each digit information. The blanking is necessary to prevent unwanted glowing of unactivated segments of the display digit, and also to avoid the so-called streamers, which are glowings appearing between adjacent digits. In instruments with serial prefix 1, the blanking pulses are fed to the BCD to 7-segment decoder IC 181 only. From serial prefix 2, the blanking pulses are also applied to the anodes of the display B 101 via transistors TS 180 . . . TS 188.
The timing diagram fig. VIII-6 indicates how the blanking pulses are generated.
The pulses of the display multivibrator 2/6 IC 177 terminal 15 are fed to differentiating network R 191—C 140 via R 190 to the base of transistor TS 139. Its collector is connected to the blanking input 1 of IC 181 and, in instruments with serial prefix 2, via R 189 to the emitters of display driving transistors TS 180 . . . TS 188.
When the pulse on the base of TS 139 is positive the transistor will be turned off and the programmed current in the cathode driver will be zero.

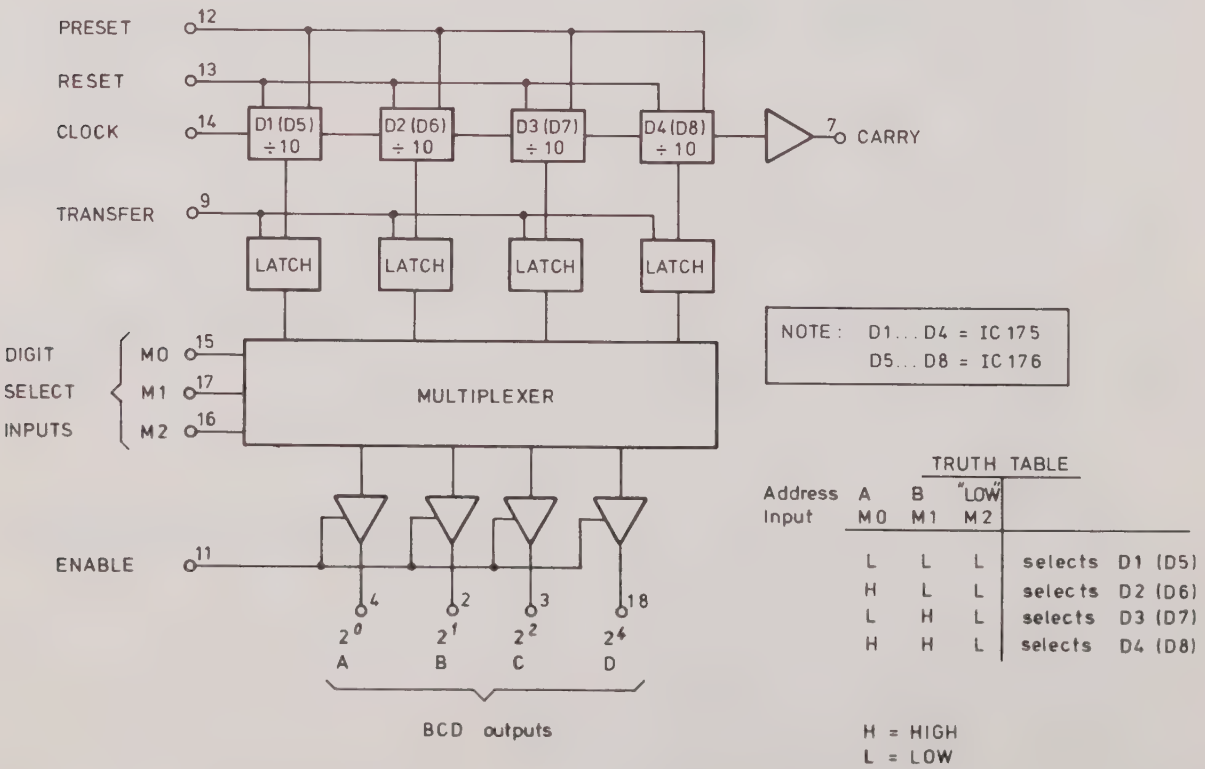


Fig. VIII-5. Block diagram of LOCMOS quad decade

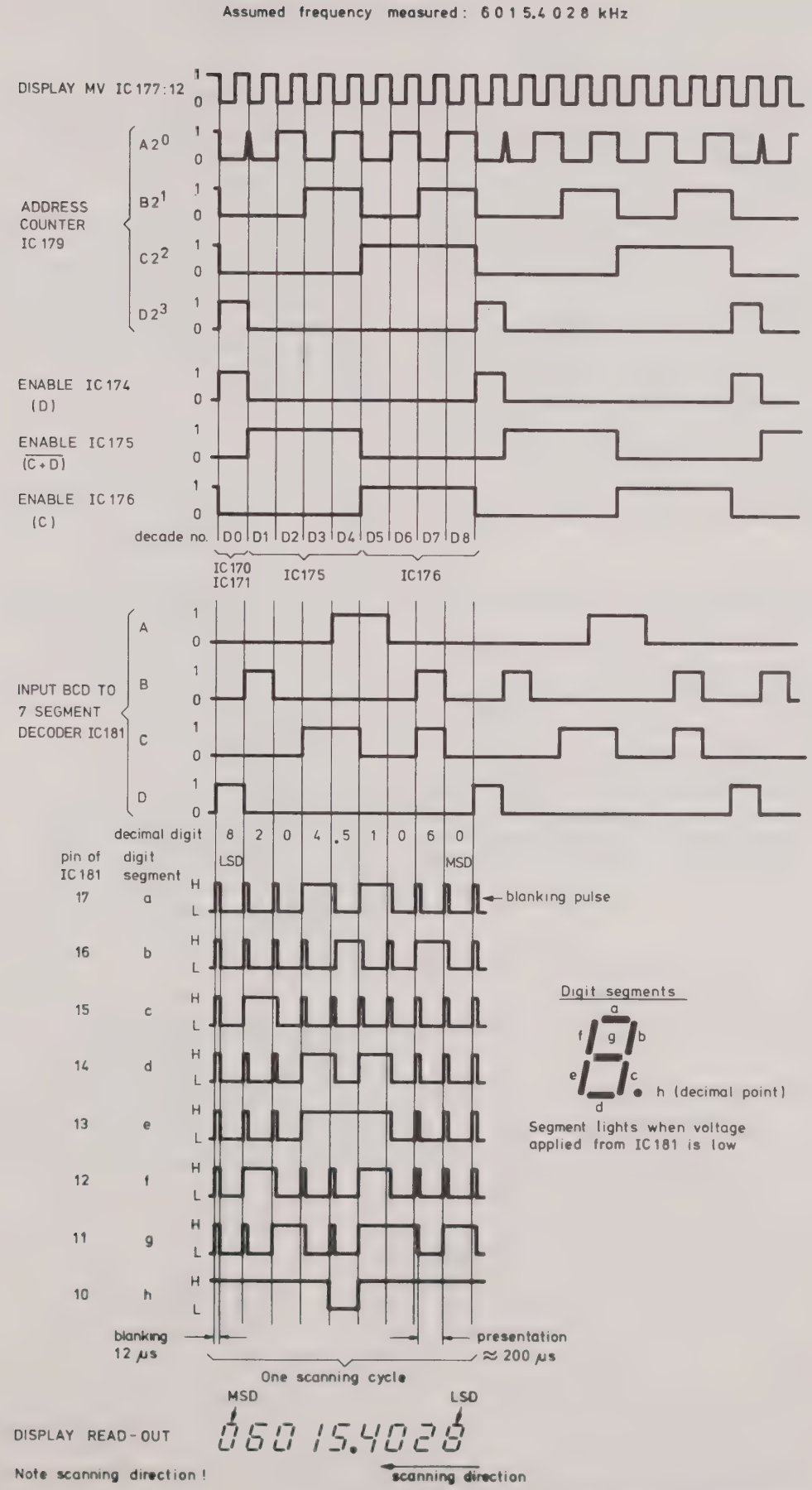


Fig. VIII-4. Timing diagram of display presentation

4.5. Display scanning

The display is scanned from the least significant digit —LSD— to the most significant digit—MSD. Only one digit lights at a time.
The pulse sequence controlling the driver transistors for the display digits is obtained from a BCD to 1 of 10 decoder IC 180 supplied with the four-line BCD information generated by the address counter IC 179. The timing diagram fig. VIII-6 illustrates how the digits are scanned. When output terminal 10 of the decoder IC 180 goes LOW, transistor TS 188 turns on and current can flow to the enabled segments of the least significant digit. Capacitor C 188 is connected between —50 V and +120 V and is changed to about 170 V which is sufficient to initiate a discharge of the segments of the display digit. The digit is presented during about 200 μs. At the next address from IC 179, output IC 180:10 goes HIGH again and output IC 180:1 goes LOW which is activating the next digit via TS 187. In the meantime, however, a 12 μs blanking pulse is generated by TS 139 which turns off all digits before the next digit segments are activated.
The scanning of the digits goes on until the most significant digit is turned on. Then the cycle starts all over again.

4.6. Decimal point setting

The Function Selector SK 105, controls the decimal point positioning in the display.
The decimal point input DP of the BCD to 7-segment decoder IC 181 is connected to pin 3 of SK 105 wafer 1. As indicated in the table in the circuit diagram fig. XIII-5 pin 3 will be connected to various outputs of the BCD to 1 of 10 decoder IC 180, except in mode COUNT A in which no decimal point is displayed. In mode FREQUENCY A and resolution 100 Hz, pins 3 and 4 are interconnected. When the "enable" pulse for digit number 4 arrives at output 4 of IC 180, it is also fed to the DP input of IC 181. A "decimal point pulse" is then fed from IC 181:10 to the decimal point 4 in the display.

5. Power supply

5.1. General

Refer to circuit diagram fig. XIII-6.

The power supply operates from 115 V AC or 230 V AC 50 to 400 Hz *or* from the internal battery PM 9673 *or* from an external battery with an output voltage of 12 to 28 V. It provides five stabilised and overload-protected voltages of +120 V, +12 V, +5 V, —5 V and —50 V.
The power supply may be divided into the *power input circuit* mainly consisting of the mains transformer T 101 and rectifier GR 167, the *over-voltage protection circuit* mainly consisting of thyristors TS 150, TS 151 and zener diode GR 160, the *voltage regulation circuit* mainly consisting of voltage regulator IC 150, thyristor TS 154, the*DC-to-DC converter* mainly consisting of primary side of transformer T 102, driver TS 152 and switch TS 153.

5.2. Power input circuit

When the power supply operates from the *mains*, the 115 V AC or 230 V AC is transformed to 20 V AC by transformer T 101, rectified in the diode-bridge GR 167, filtered by C 152 and C 161 and fed to the power supply circuits via switch SK 121 and SK 102.
When the power supply operates from an *external battery* the current to the power supply circuits is fed from BU 21 at the rear panel via protecting diode GR 164 and switches SK 121 and SK 102.
When the internal battery is used the current is fed from pin 8 of BU 105 via SK 121 and SK 102 to the power supply circuits.

5.3. Over-voltage protection

The over-voltage protection circuit consists mainly of thyristors TS 150, TS 151 and zener diode GR 160.
The anode of GR 160 is connected to the +5 V output from the power supply. If this voltage increases to 5.6 V . . . 5.8 V, the zener diode GR 160 will start to conduct and a current will flow through resistor R 1121. The voltage drop across R 1121 is fed to the gate of thyristor TS 151 via resistor R 1120. The anode is connected to the +5 V output voltage via resistor R 1118.
The thyristor will switch on and a voltage drop arises across resistor R 1122. This voltage is fed to the gate of thyristor TS 150, whose anode is connected to the d.c. input voltage. The thyristor will switch on and blow fuse VL 150, or, if the counter is operating in the internal battery mode, fuse VL 1 in the battery unit PM 9673. The capacitor across the gate and cathode of thyristor TS 151 prevents transients from the mains to blow fuse VL 150 accidentally.

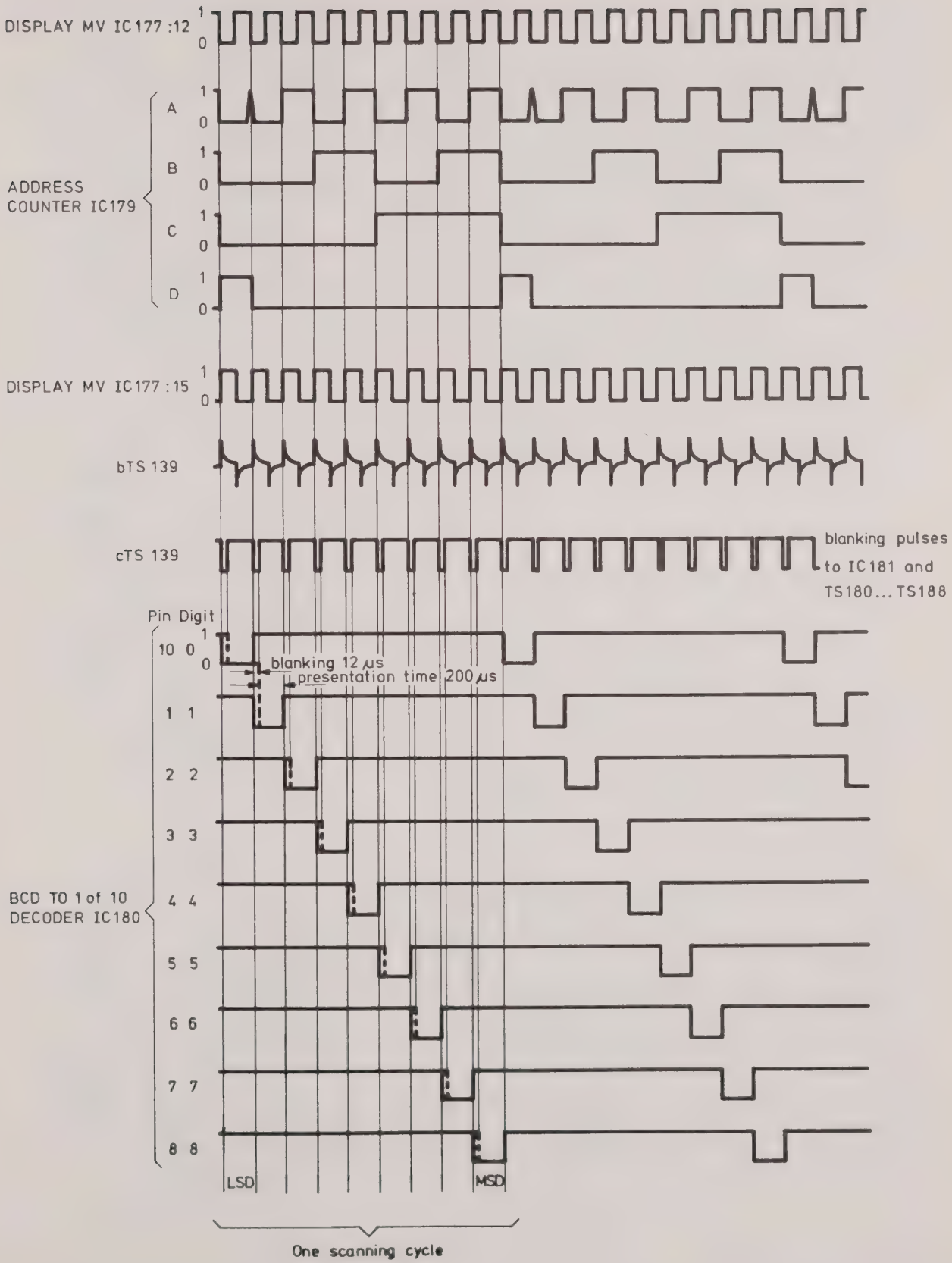


Fig. VIII-6. Timing diagram of display scanning principle and blanking pulse generation

5.4. *DC to DC converter*

Refer to diagrams fig. VIII-7.

The DC to DC converter is basically a blocking oscillator consisting mainly of switch transistor TS 153 and terminals 4—9 of the transformer T 102. When switch SK 102 is set to position ON, the DC voltage from the *power input circuit* is fed to the transistor TS 155 which works as a constant current source of approximately 1 mA (I_1).
The current I_1 will cause switch transistor TS 153 to start conducting and the linearly increasing current I_2 to flow.
This current I_2 will cause a voltage across terminals 3—8 of the transformer and the current I_3 will start to flow.
This will cause drive transistor TS 152 to saturate switch transistor TS 153. When the transistor no longer can saturate, current I_3 will stop to increase and the induced voltage at terminal 3 of transformer T 102 will disappear.
This will cause TS 153 to switch off and the collector voltage to rise to the same level as the supply voltage. At this moment the magnetic flux will discharge through the secondary windings of T 102 and diodes GR 155—159.

5.5. *Output voltage regulation circuit*

The output voltage regulation circuit consists mainly of voltage regulator IC 150 and thyristor TS 154.
The purpose of the thyristor TS 154 is to switch off the drive transistor TS 152 in order to regulate the output voltage. The switching moment of thyristor TS 154 is determined by a voltage at the gate of the thyristor which is the sum of a DC regulation voltage from terminal 10 of IC 150 and a sawtooth voltage caused by the emitter current of TS 153 through resistor R 1114//R 1115.
The voltage regulator IC 150 is fed at terminal 12 with the supply voltage and at terminal 7 with a negative voltage, via GR 161, from winding 3—8 of transformer T 102.
IC 150 contains a differential amplifier with inputs at terminals 4 and 5.
The input at terminal 5 is grounded via R 1104 and the input at terminal 4 is connected to a voltage divider that consists of the reference output at terminal 6 and the negative voltage from winding 3—8 of transformer T 102 at terminal 7.
The differential amplifier is in balance when the voltage at terminal 7 is —5 V. When the supply voltage across windings 4—9 of transformer T 102 increases, the voltage at the differential amplifier at terminal 7 of IC 150 will go more negative, the DC regulation voltage at terminal 10 of IC 150 will go positive and turn on thyristor TS 154. This will connect the base of driver transistor to the ground and cause switch transistor TS 153 to switch off. The stored magnetic flux will then discharge in the secondary windings of T 102 and diodes GR 155—GR 159.

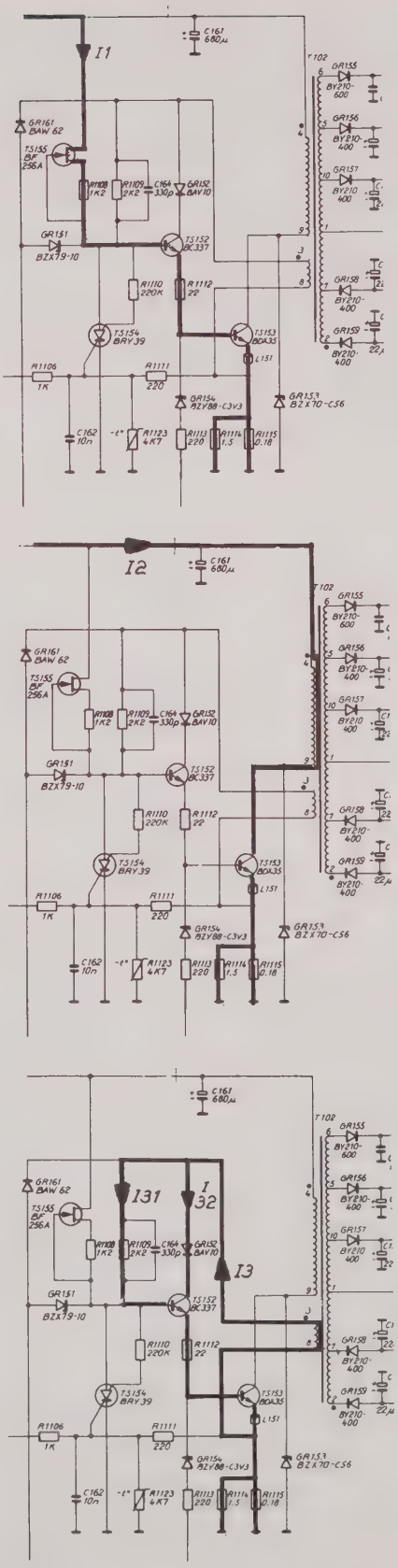


Fig. VIII-7. Current paths in DC-to-DC converter

IX. PERFORMANCE CHECK

1. Survey of check points

3. CHECK
4. RESET
5. DISPLAY TIME
6. MEMORY
7. PERIOD A
8. COUNT A START/STOP
9. RATIO A/B
10. INPUT B. Trigger mode selectors and sensitivity controls
11. TIME INTERVAL A/B
12. INPUT A. Low frequency filter and trigger mode selectors and attenuators
13. FREQUENCY A. Frequency response, sensitivity and sine wave trigger selector
14. INPUT A. Low frequency filter and square wave trigger selectors
15. INPUT A. Attenuator
16. B-OUTPUT
17. INPUT C. Frequency range and sensitivity
18. STD OUT
19. Temperature compensated crystal oscillator PM 9678
20. Oven enclosed oscillator PM 9679 and PM 9690
21. Standard oscillator PM 9677

2. Test equipment and accessories

Test-point	*Instrument or device*	*Required data*	*Recommended model*
9, 10	LF generator	Frequency: 10 MHz Amplitude: 0.5 V Signal mode: sine wave	Philips PM 5145
9, 10, 17	T-piece	BNC	Philips PM 9067
13	LF generator	Frequency: 10 Hz—1 kHz Amplitude: 20 mV Signal mode: sine wave	Philips PM 5145
13	HF generator	Frequency: 10 MHz—80 MHz Amplitude: 20 mV Signal mode: sine wave	Wavetek 2001
14	LF generator	Frequency: 100 kHz—5 MHz Amplitude: 300 mV Signal mode: sine wave	Philips PM 5145
14	HF oscillator	Frequency: 80 MHz Amplitude: 3 V Signal mode: sine wave	General Radio 1215
10, 14	Pulse generator	Frequency: 5 MHz Duration: 6 ns Amplitude: 60 mV	Philips PM 5715
14	Attenuator	20 dB	Texscan FP50 BNC Outline A
15	LF generator	Frequency: 1 kHz Amplitude: 200 mV Signal mode: sine wave	Philips PM 5145
15	HF generator	Frequency: 80 MHz Amplitude: 200 mV Signal mode: sine wave	Wavetek 2001
16	LF generator	Frequency: 3 MHz Amplitude: 20 mV Signel mode: Sine wave	Philips PM 5145
17	LF generator	Frequency: 10 MHz Amplitude: 0.6 V Signal mode: sine wave	Philips PM 5145
17, 18	Oscilloscope	Bandwidth: 50 MHz	Philips PM 3250
18	Probe to BNC conversion bush	5 kohm, 100 × attenuation	Included in Philips PM 9343
19	Reference oscillator	Accuracy 1×10^{-7}	Philips PM 9680*, PM 9681* and PM 9690*
20	Reference oscillator	Accuracy 3×10^{-8}	Philips PM 9680*, PM 9681* and PM 9690*
20	Reference oscillator	Accuracy 1×10^{-9}	HP 105*
20	Sampling oscilloscope	Bandwidth > 1 GHz	Philips PM 3400
21	Reference oscillator	Accuracy 1×10^{-6}	Philips PM 9680*, PM 9681* and PM 9690*

* To be checked against a frequency standard such as Droitwich or HBG.

3. CHECK

3.1. Set the controls of the counter:

DISPLAY TIME ❶	mid position
CHECK ❼ ❿	depressed
FUNCTION ⓫	0.1 s

3.2. Rotate FUNCTION selector ⓫ and check displayed value and GATE lamp ❷.

Function selector	*Display read-out ± 1 digit*	*Gate lamp is on during:*
0.1 s	10000.00	100 ms
1 s	10000.000	1 s
10 s	10000.0000	10 s
$n = 1$	0.1	—
$n = 10^2$	0.100	≈ 100 ms
$n = 10^4$	0.10000	≈ 100 ms

4. RESET

4.1. Set the controls of the counter:

FUNCTION ⓫	1 s
CHECK ❼ ❿	depressed
DISPLAY TIME ❶	mid position

4.2. Check that display read-out is 10000.000 ± 1 digit and that GATE lamp ❷ is turned on during one second.

4.3. Pull DISPLAY TIME switch ❶ and depress RESET push-button ⓭. Check that GATE lamp ❷ is turned off and that display read-out is 0.000.

4.4. Release RESET push-button ⓭ and check that display read-out is 10000.000 ± 1 digit and that GATE lamp ❷ is turned on once during one second.

5. DISPLAY TIME

5.1. Set the controls of the counter:

FUNCTION ⓫	1 s
CHECK ❼ ❿	depressed
MEMORY ⓬	released
DISPLAY TIME ❶	depressed, position ON

5.2. Check that display read-out is 10000.00 ± 1 digit and that flashing frequency of the GATE lamp ❷ is approximately five flashes every second.

5.3. Rotate DISPLAY TIME potentiometer ❶ slowly from position ON to position MAX and observe how flashing frequency of the GATE lamp ❷ decreases to approximately one flash every five seconds in position MAX.

5.4. Pull DISPLAY TIME switch ❶ and check that display shows 10000.00 ± 1 digit and that GATE lamp ❷ is turned off.

6. MEMORY

6.1. Set the controls of the counter:

FUNCTION ⓫	10 s
CHECK ❼ ❿	depressed
DISPLAY TIME ❶	mid position
MEMORY ⓬	depressed

6.2. Observe the display and check that the counter is counting during 10 seconds and shows 10000.0000 ± 1 digit during approximately one second.

6.3. Observe the GATE lamp ❷ and check that it is turned on during the counting time (10s) and turned off during the time the result is presented at the display (1s).

6.4. Release MEMORY push-button ⓬ and check that the display shows 10000.0000 ± 1 digit permanently.

7. PERIOD A

Test set up

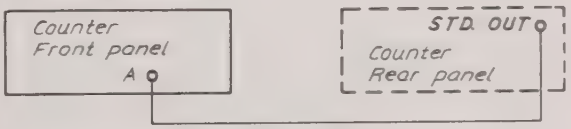
7.1. Set the controls of the counter:

DISPLAY TIME ❶	position ON
FUNCTION ⓫	PERIOD A, $n = 10^4$
TRIGGER SELECTOR A ❼	depressed
MEMORY ⓬	released
SENSITIVITY A ❸	fully CW

7.2. Check that display read-out is 0.10000 ± 1 digit.

8. COUNT A START/STOP

Test set up



8.1. Set the controls of the counter:

DISPLAY TIME ❶	position ON
FUNCTION ⓫	COUNT A
MEMORY ⓬	released (position STOP)
SENSITIVITY A ❸	pulled
TRIGGER SELECTOR A ❼	depressed

8.2. Depress push-button MEMORY ⓬ (position START) and check at the display that the counter is adding the input pulses.

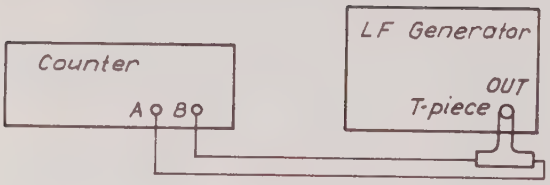
8.3. Release push-button MEMORY ⓬ (position STOP) and check at the display that the counter stops adding. The display is now showing the amount of pulses counted in the time interval between depressing and releasing the push-button MEMORY ⓬ (START/STOP).

8.4. Depress push-button RESET ⓭ and check that display shows zero.

8.5. Pull switch DISPLAY TIME ❶ and repeat steps 8.2 to 8.4.

9. RATIO A/B

Test set up



9.1. Set the controls of the counter:

FUNCTION ⓫	RATIO n = 10^2
DISPLAY TIME ❶	position ON
TRIGGER SELECTOR A ❼	depressed
SENSITIVITY A ❸	pulled
SENSITIVITY B ❸	fully CW

9.2. Set the controls of the low frequency generator.

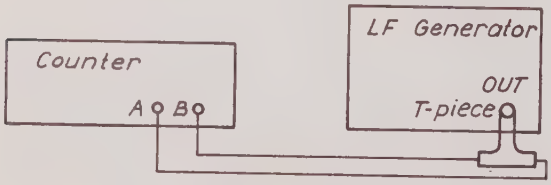
Frequency:	10 MHz
Amplitude:	20 mV
Signal mode:	Sine wave

9.3. Check that display read-out is 1.00 ± 1 digit.

9.4. Set FUNCTION selector ⓫ to position n = 10^4. Check that display read-out is 1.0000 ± 1 digit.

10. INPUT B. Trigger mode selectors and sensitivity controls

Test set up



10.1. Set the controls of the counter:

DISPLAY TIME ❶	position ON
FUNCTION SELECTOR ⓫	RATIO n = 10^2
TRIGGER SELECTOR A + B ❼	depressed
SENSITIVITY A ❸	fully CW, pulled
SENSITIVITY B ❸	fully CW

10.2. Set the controls of the generator:

Amplitude:	30 mV
Frequency:	100 Hz
Signal mode:	Sine wave

10.3. Check that display read-out is 1.00 and that the counter is gating.

10.4. Slowly decrease the amplitude of the signal from the generator until display read-out becomes wrong or the counter stops gating. Stop.
Slowly increase the amplitude until display read-out becomes correct and the counter is gating. Stop.

10.5. Check that the amplitude of the signal is less than 20 mV.

10.6. Set the frequency of the generator to 10 MHz and the amplitude to 20 mV

10.7. Repeat steps 10.3. and 10.4.

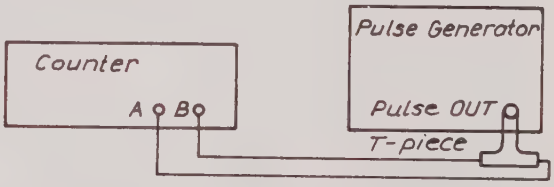
10.8. Check that the signal is less than 20 mV.

10.9. Turn SENSITIVITY B potentiometer ❸ fully CCW and set the amplitude of the generator to 500 mV.

10.10. Repeat steps 10.3. and 10.4.

10.11. Check that the amplitude is ≦ 400 mV.

Change test set up



10.12. Set the controls of the counter:

TRIGGER SELECTOR A + B ❻	depressed
SENSITIVITY B ❸	fully CW
FUNCTION SELECTOR ⓫	RATIO n = 10^2
TRIGGER SELECTOR A + B ❼	depressed
DISPLAY TIME ❶	position ON

10.13. Set the controls of the pulse generator

Frequency:	100 kHz
Amplitude:	100 mV
Duration:	50 ns

10.14. Repeat steps 10.3. and 10.4.

10.15. Check that the signal is less than 60 $mV_{p\text{-}p}$.

10.16. Depress trigger selectors A + B ❹.

10.17. Set the amplitude of the pulse generator to 100 $mV_{p\text{-}p}$ and inverted pulse mode.

10.18. Repeat steps 10.3. and 10.4.

10.19. Check that the signal is less than 60 $mV_{p\text{-}p}$.

11. TIME INTERVAL A/B

Test set up

11.1. Set the controls of the counter:

FUNCTION SELECTOR ⓫	TIME INTERVAL ms
MEMORY ⓬	depressed
SENSITIVITY A+B ❸	fully CW
TRIGGER SELECTOR A+B ❼	depressed
DISPLAY TIME ❶	position ON

11.2. Check that the counter is counting, that the gate lamp is on and that the 5:th digit from the left is changing every second.

11.3. Disconnect the signal to INPUT A and check that the counter keeps on counting.

11.4. Connect the signal from STD OUT to INPUT B and check that the counter stops counting and that gate lamp turns off.

11.5. Set FUNCTION SELECTOR to position TIME INTERVAL μs and repeat steps 11.2. to 11.5. This time, however, the second digit from the left should change every second.

12. INPUT A with low frequency filter, trigger mode selectors and attenuator

Test set up

12.1. Set the controls of the counter:

DISPLAY TIME ❶	position ON
FUNCTION ⓫	1 s
TRIGGER SELECTOR A ❼	depressed
SENSITIVITY A ❸	fully CW, depressed

12.2. Check that display read-out is 10000.000. Depress LOW FREQUENCY FILTER push-button ⓾ and check that display read-out is 0.000.

12.3. Depress TRIGGER SELECTOR push-button ❼ and set FUNCTION SELECTOR rotary switch ⓫ to position 0.1 s. Check that display read-out is 10000.00.

12.4. Turn SENSITIVITY potentiometer ❸ slowly counter clockwise until display shows zero. Stop. Turn the potentiometer slowly clockwise until display shows 10000.00. Stop.

12.5. Depress TRIGGER SELECTOR push-button ❻ and check that display shows zero.

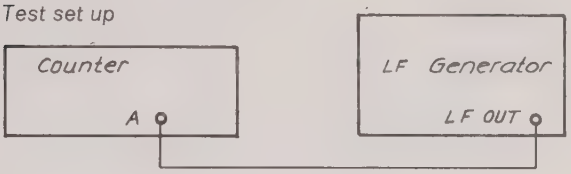
12.6. Depress TRIGGER SELECTOR push-button ❹ and check that display shows zero.

12.7. Pull SENSITIVITY switch ❸ turn it fully CW and check that display shows 10000.00.

12.8. Depress TRIGGER SELECTOR push-button ❻ and check that display shows 10000.00.

13. FREQUENCY A. Frequency response, sensitivity and sine wave trigger selector

Test set up



13.1. Set the controls of the counter:

FUNCTION ⓫	FREQUENCY 1 s
DISPLAY TIME ❶	Position ON
TRIGGER SELECTOR A ❼	depressed
SENSITIVITY A ❸	pulled, fully clockwise

13.2. Set the controls of the low frequency generator:

Amplitude:	20 mV
Frequency:	10 Hz
Signal mode:	sine wave

13.3. Check that display read-out is 0.010.

13.4. Slowly decrease the amplitude of the signal from the low frequency generator until display read-out becomes wrong. Stop. Slowly increase the amplitude just until display read-out becomes correct. Stop.

13.5. Check by means of an oscilloscope that the amplitude of the sgnal s less than 56 mV_{p-p}.

13.6. Set the frequency of the low frequency generator to 20 Hz and the amplitude to 20 mV.

13.7. Check that display read-out is 0.020 and repeat step 13.4.

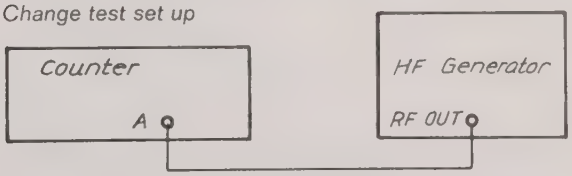
13.8. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}.

13.9. Set the frequency of the low frequency generator to 1 kHz and the amplitude to 20 mV.

13.10. Check that display read-out is 1.000 and repeat step 13.4.

13.11. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}.

Change test set up



13.12. Set the controls of the high frequency generator:

Frequency:	1 MHz
Amplitude:	20 mV
Signal mode:	sine wave

13.13. Check that display read-out is 10000.000 and repeat step 13.4.

13.14. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}.

13.15. Set the frequency of the high frequency generator to 80 MHz and the amplitude to 20 mV.

13.16. Check that display read-out is 80000.000 and repeat step 13.4.

13.17. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}

14. INPUT A. Low frequency filter and square wave trigger selectors

Test set up

14.1. Set the controls of the counter:

DISPLAY TIME A ❶	position ON
FUNCTION ⓫	FREQUENCY 1 s
LOW FREQUENCY FILTER ⓾	depressed
SENSITIVITY A ❸	pulled, fully clockwise

14.2. Set the controls of the low frequency generator:

Frequency:	100 kHz
Amplitude:	20 mV
Signal mode:	sine wave

14.3. Check that display read-out is 100.000.

14.4. Slowly decrease the amplitude of the signal from the low frequency generator until display read-out becomes wrong. Stop. Slowly increase the amplitude until display read-out becomes correct. Stop.

14.5. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}.

14.6. Set the frequency of the low frequency generator to 500 kHz and the amplitude to 50 mV.

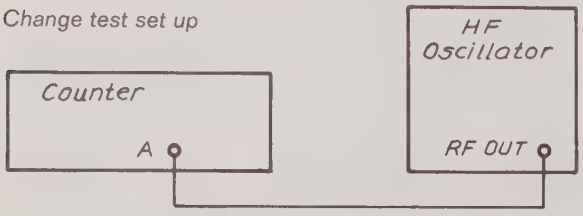
14.7. Check that the display read-out is 500.000 and repeat step 14.4.

14.8. Check by means of an oscilloscope that the amplitude is 50 to 110 mV_{p-p}.

14.9. Set the frequency of the low frequency generator to 5 MHz and the amplitude to 0.1 V.
Check that the display shows wrong read-out.

14.10. Increase the amplitude to 0.3 V and check that the display still shows wrong read-out.

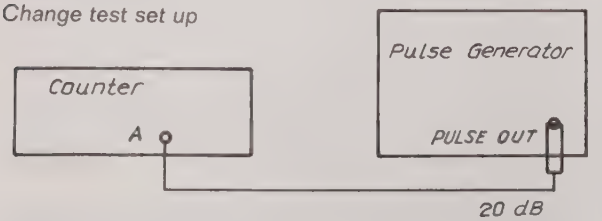
Change test set up



14.11. Set the frequency of the high frequency generator to 80 MHz and the amplitude to 1 V.
Check that the display shows wrong read-out.

14.12. Increase the amplitude to 2.4 V and check that the display still shows wrong read-out.

Change test set up



14.13. Depress TRIGGER SELECTOR ❻

14.14. Set the controls of the pulse generator:

Frequency:	5 MHz
Amplitude:	60 mV
Duration:	6 ns

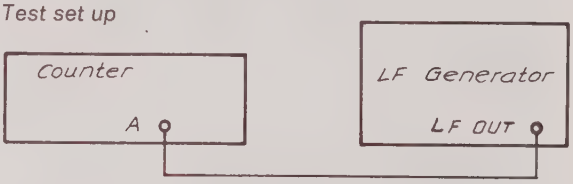
14.15. Check that the display read-out is 5000.000 and repeat step 14.4.

14.16. Check by means of an oscilloscope that the amplitude is less than 28 mV_{p-p}.

14.17. Depress TRIGGER SELECTOR ❹ and repeat steps 14.14 to 14.16 with inverted signal from the pulse generator.

15. INPUT A. Attenuator

Test set up



15.1. Set the controls of the counter:

DISPLAY TIME ❶	position ON
FUNCTION ⓫	1 s
TRIGGER SELECTOR ❼	depressed
SENSITIVITY ❸	pulled, fully clockwise

15.2. Set the controls of the low frequency generator:

Amplitude:	200 mV
Frequency:	1 kHz
Mode:	sine wave

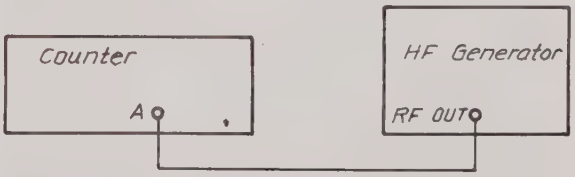
15.3. Check that display read-out is 1.000.

15.4. Turn SENSITIVITY potentiometer ❸ from fully clockwise to fully counter clockwise and check that display read-out is 1.000.

15.5. Slowly decrease the amplitude of the sine wave signal until the display shows wrong read-out. Stop. Slowly increase the amplitude until display read-out becomes 1.000. Stop.

15.6. Check the amplitude of the sine wave signal. Typical value is 150 mV.

Change test set up



15.7. Set the controls of the high frequency generator:

Amplitude:	200 mV
Frequency:	80 MHz
Signal mode:	sine wave

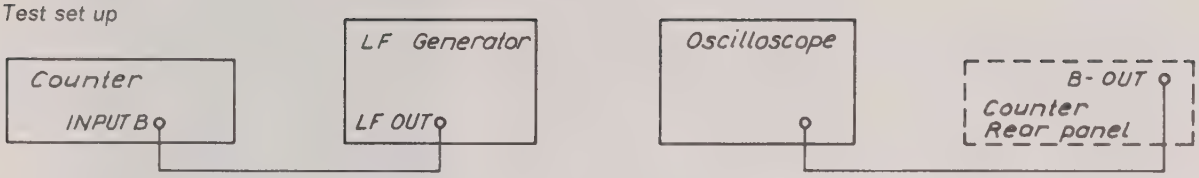
15.8. Check that display read-out is 80000.000.

15.9. Slowly decrease the amplitude of the sine wave signal until the display shows wrong read-out. Stop. Slowly increase the amplitude until display read out becomes 80000.000. Stop.

15.10. Check the amplitude of the sine wave signal. Typical valve is 150 mV.

16. B-OUTPUT

Test set up



16.1. Set the oscilloscope to 1 v/div and 50 ms/div.

16.2. Set the generator to sine wave mode, frequency 3 HMz and an amplitude of more than 20 mV.

16.3. Check that the oscilloscope displays a signal with waveform and amplitude similar to figure IX-2.

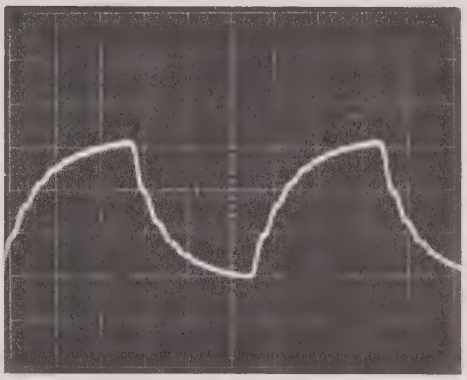


Fig. IX-2. B out

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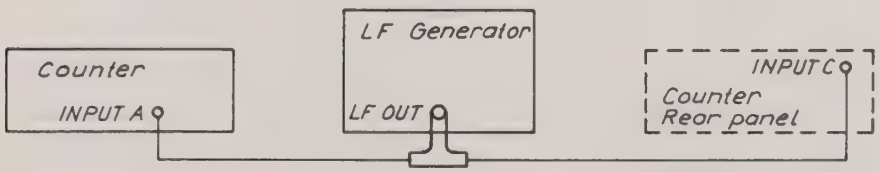
17. INPUT C. Frequency range and sensitivity

Test set up



17.1. Set the controls of the counter:

FUNCTION ⓫	FREQUENCY 1 s
SENSITIVITY ❸	pulled, fully clockwise
DISPLAY TIME ❶	position ON
TRIGGER SELECTOR ❼	depressed

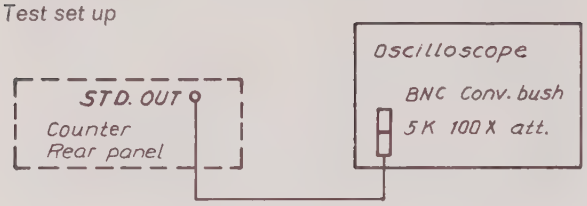
17.2. Set the frequency of the signal from the generator to 10 MHz and the amplitude to 600 mV.
Check that display shows 10000.000.

17.3. Slowly decrease the amplitude of the signal until display shows wrong read-out. Stop.
Slowly increase the amplitude until display shows correct read-out. Stop.

17.4. Check that the amplitude of the signal is less than 500 mV.

18. STD OUT

Test set up



18.1. Set the sampling oscilloscope to 10 mV/cm and 20 ns/cm.

18.2. Check that oscilloscope displays a signal with waveform and amplitude similar to figure IX-1.

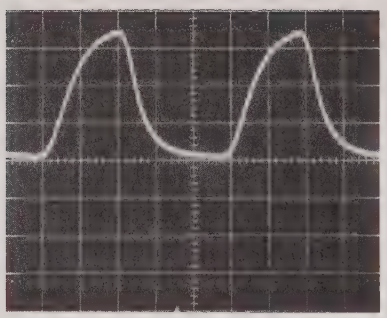


Figure IX-1. STD OUT signal, internal 10 MHz displayed.

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19. Temperature compensated crystal oscillator PM 9678

Test set up

19.1. This check requires a frequency standard having an accuracy of 1×10^{-7}.

The oven enclosed oscillators Philips PM 9680, PM 9681 and PM 9690 meet this requirement.
The check should preferably be made at an ambient temperature of +25° C.

19.2. Set the controls of the counter:

FUNCTION ⓫ FREQUENCY 10 s
TRIGGER SELECTOR ❼ depressed

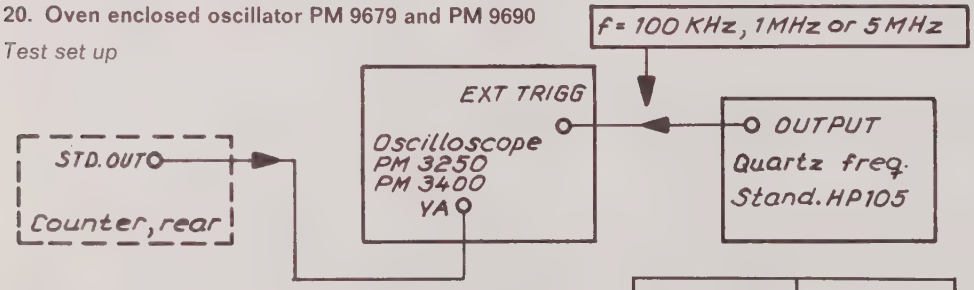
19.3. Check that the display shows 10000.0000 kHz ±1 Hz.

19.4. For adjustment instruction refer to chapter XI in the service manual.

---

20. Oven enclosed oscillator PM 9679 and PM 9690

Test set up



20.1. This check requires a frequency standard having an accuracy of 3×10^{-8} for PM 9679. The oven enclosed oscillators Philips PM 9680, PM 9681 and PM 9690 meet this requirement. For PM 9690 an accuracy of 1×10^{-9} is required. The quartz oscillator HP 105 meets this requirement.

CAUTION. The oscillator must have been operating continuously for at least 72 h before any check is made.

Waveform moves	*Oscillator frequency*
→	too low
←	too high

20.2. Observe the movement of the displayed waveform:

20.3. For adjustment instruction refer to chapter XI in the service manual.

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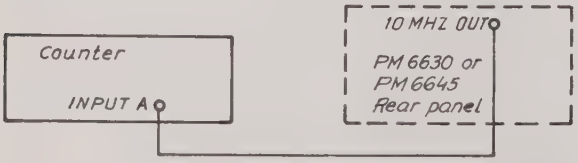
21. Standard oscillator PM 9677

Test set up



21.1. This check requires a frequency standard having an accuracy of 1×10^{-6}. The oven enclosed oscillators Philips PM 9690, PM 9681 and PM 9690 meet this requirement. The check should preferably be made at an ambient temperature of +25° C.

21.2. Set the controls of the counter:

FUNCTION ⓫ FREQUENCY 1 s
TRIGGER SELECTOR ❼ depressed

21.3. Check that display shows 10000.000 kHz ±10 Hz.

21.4. For adjustment instruction refer to chapter XI in the service manual.

X. INTERNAL CHECKS AND ADJUSTMENTS

The tolerances mentioned in the following text apply to newly adjusted instruments only. The value may differ from those given in chapter II Technical Data.

Note: Always check the d.c. supply voltage before any adjustments are made!

1. Use figure XIII-2 to identify location of trimmers and check points.

2. Test equipment

Check point	*Instrument*	*Required data*	*Recommended model*
3	Voltmeter	5—150 V d.c.	Philips PM 2412
4 5	Oscilloscope	50 MHz bandwidth	Philips PM 3250
4 5	Probe	Passive 10 MΩ/11 pF	Philips PM 9336
4	LF generator	Frequency 10 kHz Amplitude 10 mV Signal mode sinewave	Philips PM 5145
5	Pulse generator	Frequency 10 kHz Amplitude 1 V Duty factor 0.5	Philips PM 5715 or PM 5705

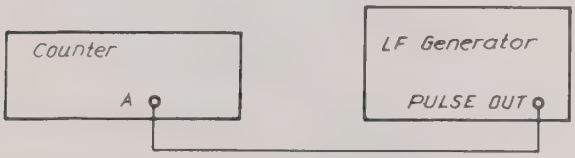
3. D.C. voltages

3.1. Connect voltmeter to jumper connector BU104 and check the d.c. voltages according to table below.

Testpoint	*Measured voltage*
+120	+115 to 130 V
+5.2	+4.8 to 5.2 V
+12	+11.5 to 13.0 V
—5.2	—5.2 to —6.0 V
—50	—50 to —60 V

4. D.C. balance channel A

Test set up



4.1. Set the controls of the counter:

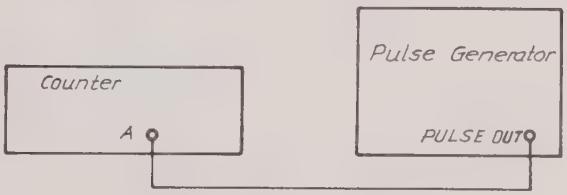
TRIGGER SELECTOR ❼ depressed
SENSITIVITY ❸ pulled, fully clockwise

4.2. Set the controls of the low-frequency generator:

Frequency : 1 kHz
Amplitude : 10 mV
Signal mode: Sine wave

4.3. Connect the oscilloscope via a well-adjusted 10 MΩ/11 pF probe to junction L101/R132.
Adjust R127 until displayed waveform has duty factor 0.5.

5. Frequency compensation channel A



5.1. Set the controls of the counter:

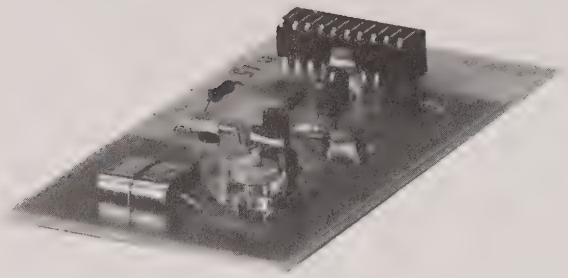
TRIGGER SELECTOR ❼ depressed

5.2. Set the controls of the pulse generator:

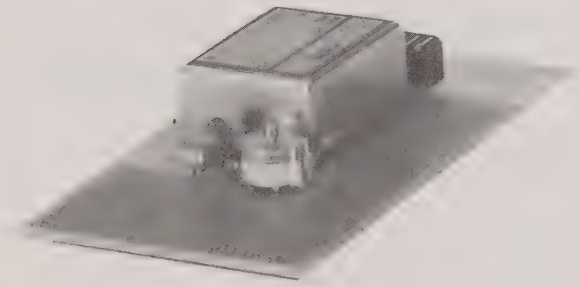
Frequency : 10 kHz
Amplitude : 1 V
Duty factor: 0.5

5.3. Connect the oscilloscope to L103 via a well-adjusted 10 MΩ/11 pF probe.
Adjust C102 to best square-wave symmetry of displayed waveform.

XI. OSCILLATORS PM 9677, PM 9678, PM 9679 and PM 9690



PM 9677
9446 096 770.1



PM 9678
9446 096 780.1

PM 9679
9446 096 790.1

PM 9690
9446 096 900.1

1. General

The oscillators are made as plug-in cards and have a nominal frequency of 10 MHz.

2. Technical data

2.1. Electrical	*PM 9677*	*PM 9678*	*PM 9679*	*PM 9690*
Nominal frequency, MHz	10.000 000	10.000 000	10.000 000	10.000 000
Trimming range, Hz	> ± 200	> ± 20	+20*) —30	+3*) —7
Output voltage, mV (into 1 kohm)	> 300	> 100	> 150	> 50
Supply voltage, V	+ 12	+ 12	+ 11.5 to 28 (from unregulated power supply)	+ 11.5 to 28 (from unregulated power supply)
Power consumption (+25°C)				
Continuous operation	< 100 mW	< 200 mW	< 100 mA	< 125 mA
Stand by	none	none	< 100 mA	< 125 mA
Warm up	none	none	< 400 mA	< 400 mA
Stability against:				
Ageing	$< 5\times10^{-7}$/month	$< 1\times10^{-7}$/month**)	$< 1\times10^{-7}$/month	$< 1.5\times10^{-9}$/24 h (after 72 hours of continuous operation)
Temperature 0 . . . 50°C (ref. to +25°C)	$< 1\times10^{-5}$	$< 1\times10^{-6}$	$< 1\times10^{-7}$	$< 3\times10^{-8}$
Line voltage ± 10 %	$< 1\times10^{-8}$	$< 1\times10^{-9}$	$< 1\times10^{-9}$	$< 5\times10^{-10}$
Change of measuring mode and change between line, ext. and int. battery	$< 3\times10^{-7}$	$< 5\times10^{-8}$	$< 1\times10^{-8}$	$<3\times10^{-9}$
Warm up time (to reach 1×10^{-7})			< 10 min	< 15 min

2.2. Environmental				
Temperature				
Storage, °C	—40 to +70	—40 to +70	—40 to +70	—40 to +70
Operating, °C	0 to +50	0 to +50	0 to +50	0 to +50
Altitude				
Storage, m	15000	15000	15000	15000
Operating, m	5000	5000	5000	5000
Humidity at 50°C	10—90 % RH (26° dew point)	10—90 % RH (26° dew point)	10—90 % RH (26° dew point)	10—90 % (26° dew point)
Shock	Meets the requirement of the IEC Eb recommendations } all oscillators			
Vibration	Meets the requirement of the IEC 68F recommendations }			

2.3. Mechanical				
Dimensions, mm	93×50×20	93×50×15	100×52×35	100×52×35
Weight, g	50	25	100	100

*) The indicated values regard only the fine trimming range. A coarse trimmer is available on the PM 9679 and PM 9690 to adjust for an ageing of more than 10 years.

**) Trimming range will cover at least 10 years of operation since the ageing will decrease substantially after the first 6 months.

3. Frequency adjustment PM 9677

3.1. This adjustment requires a reference oscillator having an accuracy of $\leq 1 \times 10^{-6}$.
The oven enclosed PHILIPS oscillators PM 9680*, PM 9681* and PM 9690* meet this requirement.
The adjustment should preferably be made at an ambient temperature of +25°C.
3.2. Remove the bottom cover of the counter.
3.3. Connect the reference signal available at socket 10 MHz OUT of the external counter to INPUT A of the counter to be adjusted.
3.4. Set the controls of the counter to be adjusted:
FUNCTION SELECTOR ⓫: FREQUENCY 1 Hz (1s)
TRIGGER SELECTOR ❼ : depressed
3.5. Adjust trimming capacitor C 1 to 10000.000 kHz plus or minus 10 Hz.

4. Frequency adjustment PM 9678

4.1. This adjustment requires a reference oscillator having an accuracy of $\leq 1 \times 10^{-7}$.
The oven enclosed PHILIPS oscillator PM 9680*, PM 9681* and PM 9690* meet this requirement.
The adjustment should preferably be made at an ambient temperature of +25°C.
4.2. Remove the bottom cover of the counter.
4.3. Connect the reference signal available at socket 10 MHz OUT of the external counter to INPUT A of the counter to be adjusted.
4.4. Set the controls of the counter to be adjusted:
FUNCTION SELECTOR ⓫: FREQUENCY 1 Hz (1s)
TRIGGER SELECTOR ❼ : depressed.
4.5. Adjust trimming capacitor C 1 to 10000.000 kHz plus or minus 1 Hz.
4.6. Set FUNCTION SELECTOR ⓫ to position 0.1 Hz (10s) and check that display read-out is the same as before. If not, adjust C 1 slightly to correct frequency.

5. Frequency adjustment PM 9679

5.1. This adjustment requires a reference oscillator having an accuracy of $\leq 3 \times 10^{-8}$.
The oven enclosed PHILIPS oscillators PM 9680*, PM 9681* and PM 9690* meet this requirement.
The adjustment should preferably be made at an ambient temperature of 25°C and the oscillator must have been operating continuously 72 h before any adjustment is made.
5.2. Remove the bottom cover of the counter.
5.3. Connect the reference signal available at socket 10 MHz OUT of the external counter to socket EXT. TRIGG of oscilloscope PHILIPS PM 3250 or PM 3400.
5.4. Connect the oscillator signal available at socket 10 MHz OUT of the counter to be adjusted to INPUT A of the oscilloscope.
5.5. Set oscilloscope to 100 ns/div and adjust trimming potentiometer R 208 until waveform moves with a velocity of maximum 1 div./3 s (0.3 Hz).
If the adjustment range of R 208 is too narrow perform the following steps 5.6 to 5.12.
5.6. Set trimming potentiometer R 208 to fully clockwise position.
5.7. Remove the two screws fixing the oscillator's text plate to the box.
5.8. Remove the small plastic cylinder beneath the text plate using a pair of tweezers.
5.9. Connect an external counter to socket 10 MHz OUT at the rear panel of the counter to be adjusted.
5.10. Adjust trimming capacitor C 108 until the display read out of the external counter is 10000020 Hz.
5.11. Refit the plastic cylinder and the text plate.
5.12. Perform steps 5.3 to 5.5.

6. Frequency adjustment PM 9690

6.1. This adjustment requires a reference frequency having an accuracy of $\leq 1 \times 10^{-9}$.
Hewlett-Packard quartz frequency standard HP 105* meets this requirement.
The adjustment should preferably be made at an ambient temperature of 25°C and the oscillator must have been operating continuously 72 h before any adjustment is made.
6.2. Remove the bottom cover of the counter.
6.3. Connect any of the three reference signals available at sockets 5 MHz, 1 MHz and 100 kHz of the HP 105 to socket EXT. TRIGG of oscilloscope PHILIPS PM 3250 or PM 3400.
6.4. Connect the oscillator signal available at socket 10 MHz OUT of the counter to be adjusted to INPUT A of the oscilloscope.
6.5. Set oscilloscope to 100 ns/div and adjust trimming potentiometer R 208 until waveform moves with a velocity of maximum 1 div/10 s (0.1 Hz).
If the adjustment range of R 208 is too narrow perform the following steps 6.6 to 6.12.
6.6. Set trimming potentiometer R 208 to fully clockwise position.
6.7. Remove the two screws fixing the oscillator's text plate to the box.
6.8. Remove the small plastic cylinder beneath the text plate using a pair of tweezers.
6.9. Connect an external counter to socket 10 MHz OUT at the rear panel of the counter to be adjusted.
6.10. Adjust trimming capacitor C 108 until the display read out of the external counter is 10000003 Hz.
6.11. Refit the plastic cylinder and the text plate.
6.12. Perform steps 6.3 to 6.5.

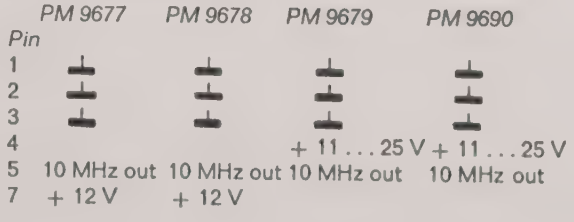
7. Repair of oscillator PM 9679 and PM 9690

7.1. Repair of these oscillators may not be carried out by the local service organisations. In case of breakdown the complete sealed oscillator box has to be sent to the factory for repair.

Factory address:

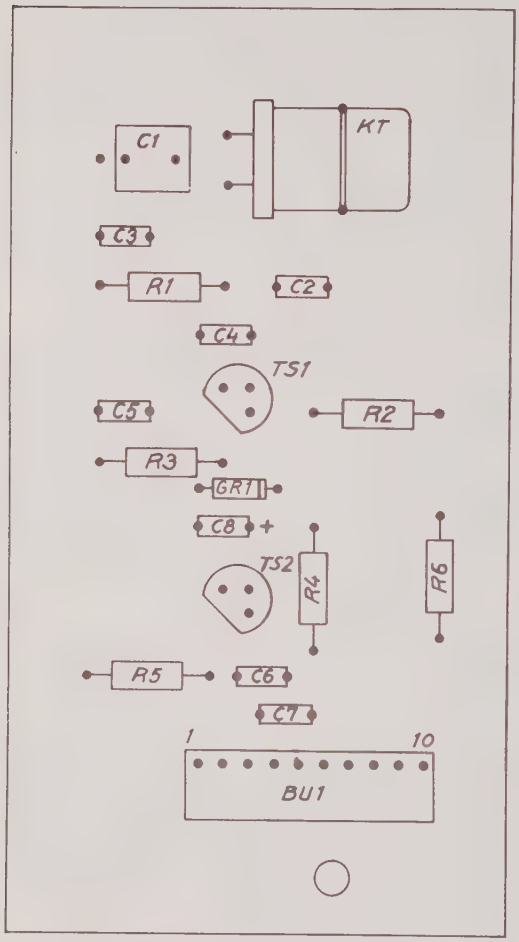
PHILIPS ELEKTRONIKINDUSTRIER AB
INDUSTRIAL OPERATIONS
FACK
S-175 20 JÄRFÄLLA
SWEDEN

8. Pin configuration



*To be checked against a frequency standard such as Droitwich or HBG.

9. Circuit diagram, component lay-out and spare parts list PM 9677



	RESISTORS		
4822 110 63161	100K	5	CR25 R1
4822 110 63116	2•2K	5	CR25 R2
4822 110 63107	1K	5	CR25 R3
4822 110 63107	1K	5	CR25 R4
4822 110 63107	1K	5	CR25 R5
4822 110 63107	1K	5	CR25 R6
	CAPACITORS		
5322 125 54029	2-18P		300 C1
4822 122 31063	22P	2	100 C2
4822 122 31072	47P	2	100 C3
4822 122 31076	68P	2	100 C4
5322 122 34041	10N	-20+50	100 C5
5322 122 34041	10N	-20+50	100 C6
5322 122 34041	10N	-20+50	100 C7
5322 124 14036	15M	-10+50	16 C8
	SEMI CONDUCTORS		
5322 130 44418	BF 256 A		TS1
5322 130 44418	BF 256 A		TS2
5322 130 30766	BZX79-C6V2		GR1
	MISCELLANEOUS		
5322 242 74036	CRYSTAL 10MHZ		
5322 267 64031	CONNECTOR		BU1

Spare parts PM 9677

Figure XI-1. Component lay-out PM 9677

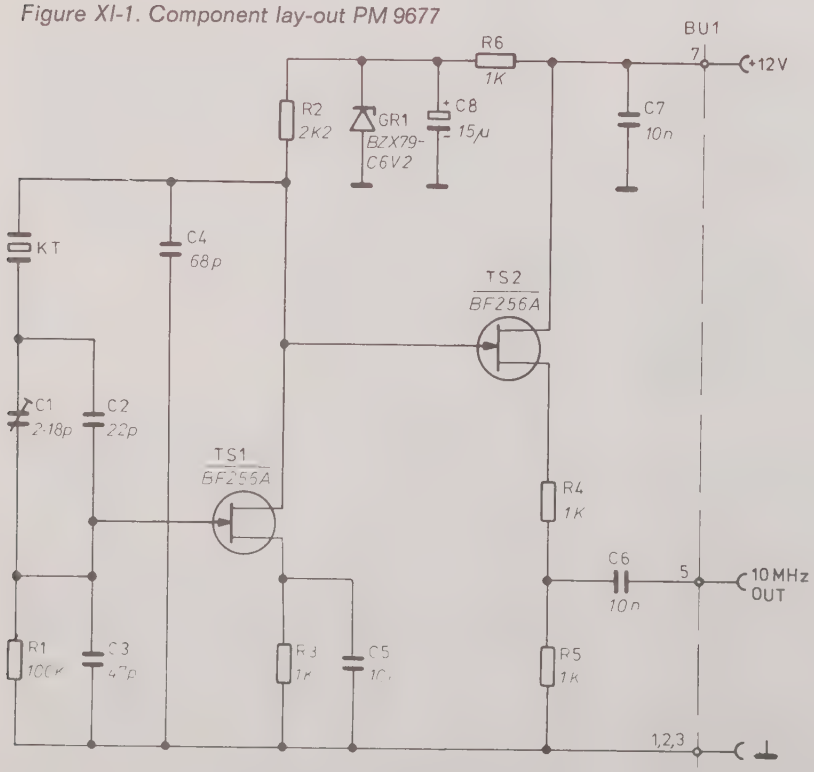


Figure XI-2. Circuit diagram PM 9677

10. Circuit diagram, component lay-out and spare parts list PM 9678

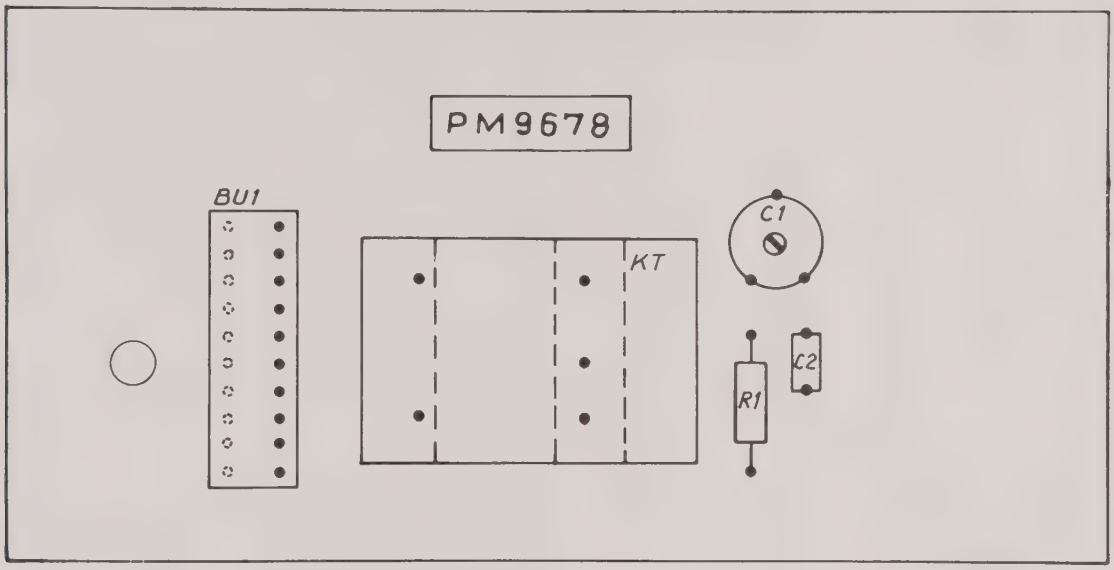


Figure XI-3. Component lay-out PM 9678

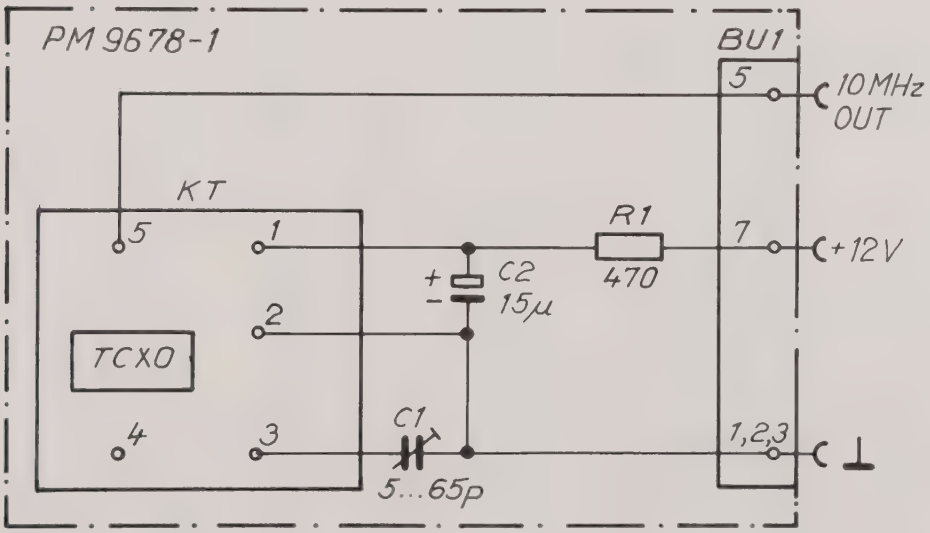


Figure XI-4. Circuit diagram PM 9678

ORDERING NUMBER

4822 110 63098	470 Ω 5 %		R 1
5322 125 50057	5–65 P	100 V	C 1
5322 124 14036	15 M −10 + 50 %	16 V	C 2
5322 267 64031	Connector		BU 1
5322 216 94047	Crystal 10 MHz		

XII. REPLACING PARTS

1. Push-button switches

1.1. Loosen switch by bending the four tags securing the switch to the switch bracket.

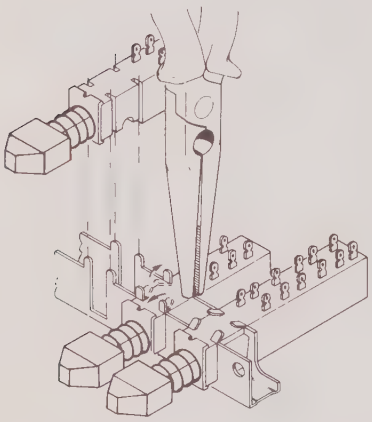


Figure XII-1. Replacing push-button switch.

1.2. Crush the switch by means of a pair of cutting pliers.

1.3. Unsolder the contact pins from the circuit board one by one. Use a sucking device to remove all tin solder from the contact holes in the circuit board before attaching the new switch.

2. Text plate and front rim

2.1. Remove the knobs for DISPLAY TIME, SENSITIVITY and function selector.

2.2. Put a screw driver between the front rim and the front frame at points A as shown in figure XII-2.

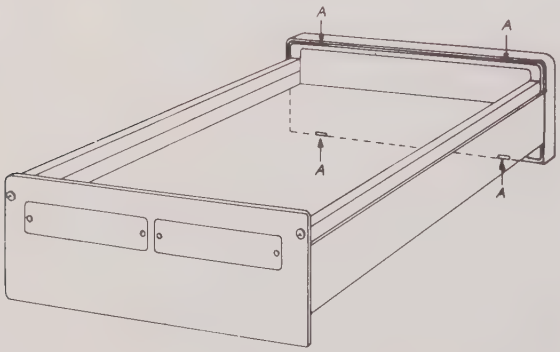


Figure XII-2. Removing the front rim.

2.3. Pry gently until front rim comes off.

2.4. Remove the text plate.

3. Handle

3.1. Remove the two plastic caps using a tiny screw driver or a pair of pliers.

3.2. Unscrew the two screws and pull out handle.

3.3. Before assambling grease, the tooth washer screwhole and teeth of the handle *very slightly* with vaseline.

4. Power supply

When replacing parts in the power supply, in particular IC150, always check the +5,0 V supply.

Proceed as follows:

4.1. Connect a voltmeter to BU107 pin +5,2 V and check that the voltage is 4.8—5.2 V
If the measured voltage does not reach 4.8—5.2 V unsolder R 1103 and select a resistor value that gives the desired voltage. The value of this resistor may be 1 kΩ to 33 kΩ. Typical value is 8 kΩ.

4.2. Check the d.c. voltages, refer to chapter X section 3.

XIII. SPARE PARTS, FAULTFINDING, TESTPOINTS AND CIRCUIT DIAGRAMS

UNIT UI
FIXED RESISTORS

Ordering number	Ohm	Tol (%)	Type	Item
5322 116 54408	909K	1	MR30	R101
4822 110 63165	150K	5	CR25	R102
5322 116 54984	68	5	PR37	R103
4822 110 63072	47	5	CR25	R104
4822 110 63094	330	5	CR25	R105
4822 110 63098	470	5	CR25	R106
4822 110 63087	180	5	CR25	R109
4822 110 63116	2,2K	5	CR25	R110
4822 110 63072	47	5	CR25	R111
4822 110 63141	18K	5	CR25	R112
4822 110 63105	820	5	CR25	R113
4822 110 63105	820	5	CR25	R114
4822 110 63072	47	5	CR25	R115
4822 110 63072	47	5	CR25	R116
4822 110 63072	47	5	CR25	R117
4822 110 63105	820	5	CR25	R118
4822 110 63105	820	5	CR25	R119
4822 110 63081	100	5	CR25	R120
4822 110 63105	820	5	CR25	R121
4822 110 63103	680	5	CR25	R122
4822 110 63098	470	5	CR25	R123
4822 110 63089	220	5	CR25	R124
4822 110 63101	560	5	CR25	R128
4822 110 63123	39K	5	CR25	R129
4822 110 63067	33	5	CR25	R130
4822 110 63089	220	5	CR25	R131
4822 110 63094	330	5	CR25	R132
4822 110 63098	470	5	CR25	R133
4822 110 63107	1K	5	CR25	R134
4822 110 63063	22	5	CR25	R135
4822 110 63063	22	5	CR25	R136
4822 110 63161	100K	5	CR25	R137
4822 110 63138	15K	5	CR25	R138
4822 110 63089	220	5	CR25	R139
4822 110 63105	820	5	CR25	R140
4822 110 63138	15K	5	CR25	
4822 110 63187	1M	5	CR25	R141
4822 110 63178	470K	5	CR25	R142
4822 110 63105	820	5	CR25	R143
4822 110 63096	390	5	CR25	
4822 110 63074	56	5	CR25	R145
4822 110 63098	470	5	CR25	R147
4822 110 63152	47K	5	CR25	R148
4822 110 63152	47K	5	CR25	R149
4822 110 63134	10K	5	CR25	R150
4822 110 63107	1K	5	CR25	R151
4822 110 63089	220	5	CR25	R152
4822 110 63107	1K	5	CR25	R152
4822 110 63107	1K	5	CR25	R154
4822 110 63134	10K	5	CR25	R155
4822 110 63152	47K	5	CR25	R156
4822 110 63152	47K	5	CR25	R157
4822 110 63107	1K	5	CR25	R158
4822 110 63152	47K	5	CR25	R159
4822 110 63134	10K	5	CR25	R160
4822 110 63134	10K	5	CR25	R161
4822 110 63143	22K	5	CR25	R162
4822 110 63174	330K	5	CR25	R163
4822 110 63092	270	5	CR25	R164
4822 110 63125	4,7K	5	CR25	R165
4822 110 63125	4,7K	5	CR25	R166
4822 110 63107	1K	5	CR25	R167
4822 110 63116	2,2K	5	CR25	R168
4822 110 63101	560	5	CR25	R169
4822 110 63134	10K	5	CR25	R170
4822 110 63152	47K	5	CR25	R171
4822 110 63134	10K	5	CR25	R172
4822 110 63134	10K	5	CR25	R173
4822 110 63134	10K	5	CR25	R174
4822 110 63134	10K	5	CR25	R175
4822 110 63134	10K	5	CR25	R176
4822 110 63152	47K	5	CR25	R177
4822 110 63152	47K	5	CR25	R178
4822 110 63152	47K	5	CR25	R179
4822 110 63138	15K	5	CR25	R180
4822 110 63138	15K	5	CR25	R181
4822 110 63138	15K	5	CR25	R182
4822 110 63138	15K	5	CR25	R183
4822 110 63138	15K	5	CR25	R184
4822 110 63138	15K	5	CR25	R185
4822 110 63138	15K	5	CR25	R186
4822 110 63138	15K	5	CR25	R187
4822 110 63138	15K	5	CR25	R188
4822 110 63098	470	5	CR25	R189
4822 110 63125	4,7K	5	CR25	R190
4822 110 63143	22K	5	CR25	R191
4822 110 63129	6,8K	5	CR25	R192
4822 110 63116	2,2K	5	CR25	R193
4822 110 63116	2,2K	5	CR25	R194
4822 110 63116	2,2K	5	CR25	R195
4822 110 63116	2,2K	5	CR25	R196
4822 110 63116	2,2K	5	CR25	R197
4822 110 63116	2,2K	5	CR25	R198
4822 110 63116	2,2K	5	CR25	R199
5322 116 50524	3,01K	1	MR25	R1101
5322 116 54011	5,62K	1	MR25	R1102
SELECTED				R1103*
4822 110 63107	1K	5	CR25	R1104
4822 110 63121	3,3K	5	CR25	R1105
4822 110 63107	1K	5	CR25	R1106
4822 110 63109	1,2K	5	CR25	R1108
4822 110 63116	2,2K	5	CR25	R1109
4822 110 63169	220K	5	CR25	R1110
4822 110 63089	220	5	CR25	R1111
4822 110 63063	22	5	CR25	R1112
4822 110 63089	220	5	CR25	R1113
4822 110 63032	1,5	5	CR25	R1114
5322 116 54963	0,18	10		R1115
4822 110 63098	470	5	CR25	R1116
4822 110 63089	220	5	CR25	R1117
4822 110 63072	47	5	CR25	R1118
4822 110 63169	220K	5	CR25	R1119
4822 110 63107	1K	5	CR25	R1120
4822 110 63098	470	5	CR25	R1121
4822 110 63081	100	5	CR25	R1122
4822 116 30114	4,7K	NTC	NTC	R1123
4822 113 60084	1	10	1W	R1123
4822 110 63163	120K	5	CR25	R1129
4822 110 63116	2,2K	5	CR25	R1130
5322 116 50747	10K	5	MR25	R1138
5322 116 50747	10K	5	MR25	R1139
4822 110 63134	10K	5	CR25	R1140
4822 110 63116	2,2K	5	CR25	R1141
4822 110 63152	47K	5	CR25	R1142
4822 110 63134	10K	5	CR25	R1143
4822 110 63185	820K	5	CR25	R1144
4822 110 63134	10K	5	CR25	R1145
4822 110 63134	10K	5	CR25	R1146
4822 110 63134	10K	5	CR25	R1148
4822 110 63152	47K	5	CR25	R1149
4822 110 63134	10K	5	CR25	R1150
4822 110 63214	10M	10	CR25	R1151
4822 110 63143	22K	5	CR25	R1152
4822 110 63152	47K	5	CR25	R1153
4822 110 63152	47K	5	CR25	R1154
4822 110 63152	47K	5	CR25	R1155
4822 110 63096	390	5	CR25	R1156
4822 110 63134	10K	5	CR25	R1158
4822 110 63187	1M	5	CR25	R1159
4822 110 63134	10K	5	CR25	R1160
4822 110 63134	10K	5	CR25	R1161
4822 110 63152	47K	5	CR25	R1162

* Refer to chapter XII section 4

4822 110 63134	10K	5	CR25	R1163
4822 110 63107	1K	5	CR25	R1164
4822 110 63134	10K	5	CR25	R1165
4822 110 63134	10K	5	CR25	R1166
4822 110 63114	1,8K	5	CR25	R1167
4822 110 63114	1,8K	5	CR25	R1168
4822 110 63114	1,8K	5	CR25	R1169
4822 110 63114	1,8K	5	CR25	R1170
4822 110 63098	470	5	CR25	R1171
4822 110 63098	470	5	CR25	R1172
4822 110 63098	470	5	CR25	R1173
4822 110 63123	3,9K	5	CR25	R1174
4822 110 63116	2,2K	5	CR25	R1175

VARIABLE RESISTORS

Ordering number	Ohm			Item
5322 101 94008	500 SENSITIVITY INCL.SWITCH SK106			R107
5322 101 14069	22K	20	0,5W	R127
5322 101 34012	1K,SENSITIVITY			R146
5322 101 94007	1M DISPLAY TIME INCL.SWITCH SK101,102			R1157

FIXED CAPACITORS

Ordering number	Farad	Tol(%)	Volt	Item
4822 121 40407	22N	10	630	C101
4822 122 31076	68P	2	100	C103
4822 122 31168	270P	2	500	C104
5322 124 14036	15M	-10+50	16	C105
5322 124 14079	68M	-10+50	6,3	C106
4822 122 31177	470P	10	100	C107
5322 122 34041	10N	-20+50	100	C108
5322 124 14079	68M	-10+50	6,3	C109
4822 122 31081	100P	2	100	C110
5322 122 34041	10N	-20+50	100	C111
5322 122 34041	10N	-20+50	100	C112
4822 121 40407	22N	10	630	C113
4822 122 31168	270P		500	C114
5322 124 14053	33M	-10+50	10	C115
5322 124 14036	15M	-10+50	16	C116
5322 124 14079	68M	-10+50	6,3	C117
5322 124 14036	15M	-10+50	16	C118
5322 124 14075	15M	-10+50	16V	C120
5322 121 40323	100N	10	100	C121
5322 122 34041	10N	-20+50	100	C122
5322 122 34041	10N	-20+50	100	C123
5322 122 34041	10N	-20+50	100	C124
5322 122 34041	10N	-20+50	100	C125
5322 122 34041	10N	-20+50	100	C126
4822 122 31036	2,2P	2	100	C127
5322 124 14079	68M	-10+50	6,3	C128
4822 122 31165	330P	10	100	C129
5322 122 34041	10N	-20+50	100	C130
4822 122 31175	1N	10	100	C131
4822 121 41147	33N	10	250	C132
5322 124 14079	68M	-10+50	6,3	C133
5322 124 14079	68M	-10+50	6,3	C134
4822 122 31067	33P	2	100	C135
4822 122 31072	47P	2	100	C137
4822 122 31072	47P	2	100	C138
4822 122 30114	2,2N	10	100	C140
4822 121 40232	220N	10	100	C141
5322 122 34041	10N	-20+50	100	C150
5322 122 34041	10N	-20+50	100	C151
4822 124 20534	680M	-10+50	40	C152
4822 121 40104	150N	10	250	C153
4822 124 20586	150M	-10+50	16	C154
4822 124 20589	220M	-10+50	10	C155
4822 124 20589	220M	-10+50	10	C156
4822 124 20589	220M	-10+50	10	C157
4822 124 20589	220M	-10+50	10	C158
4822 124 20499	22M	-10+50	63	C160
4822 124 20534	680M	-10+50	40	C161
5322 122 34041	10N	-20+50	100	C162
4822 122 31165	330P	10	100	C164
5322 124 14075	1M	-10+50	25	C165
4822 121 40232	220N	10	100	C167
4822 122 31081	100P	2	100	C170
5322 122 34041	10N	-20+50	100	C169
5322 124 14066	10M	-10+50	6,3	C171
5322 121 40323	100N	10	100	C172
5322 122 34041	10N	-20+50	100	C173
5322 122 34041	10N	-20+50	100	C174
5322 121 40323	100N	10	100	C175
5322 121 40323	100N	10	100	C176
5322 122 34041	10N	-20+50	100	C177
5322 122 34041	10N	-20+50	100	C178
5322 122 34041	10N	-20+50	100	C179
5322 121 44137	68N	10	250	C180
5322 121 44137	68N	10	250	C181
5322 121 44137	68N	10	250	C182
5322 121 44137	68N	10	250	C183
5322 121 44137	68N	10	250	C184
5322 121 44137	68N	10	250	C185
5322 121 44137	68N	10	250	C186
5322 121 44137	68N	10	250	C187
5322 121 44137	68N	10	250	C188
4822 121 40104	150N	10	250	C189

VARIABLE CAPACITORS

Ordering number	Farad	Volt	Item
5322 125 54024	2-9P	300	C102

INTEGRATED CIRCUITS

Ordering number	Type	Item
5322 209 84431	MC10216P	IC101
5322 209 85205	SN72710P,TEXAS	IC102
5322 209 84304	SN75107AN,TEXAS	IC120
5322 209 84286	SN7451N , TEXAS	IC121
5322 209 84529	SN7403AN, TEXAS	IC122
5322 209 84528	SN7400N , TEXAS	IC123
5322 209 84722	GZF1201P,	IC124
5322 209 84722	GZF1201P,	IC125
5322 209 84227	SN7402N TEXAS	IC126
5322 209 80077	SN7410N	IC127
5322 209 84655	723PC ,FAIRCHILD	IC150
5322 209 84183	SN74S74N ,TEXAS	IC170
5322 209 84237	SN74S112N,TEXAS	IC171
5322 209 84724	SN74S64N ,TEXAS	IC172
5322 209 80059	SN7475N , TEXAS	IC173
5322 209 84529	SN7403N , TEXAS	IC174
5322 209 84722	GZF1201P,	IC175
5322 209 84722	GZF1201P,	IC176
5322 209 85085	F34049 SELECTED	IC177
5322 209 84227	SN7402N , TEXAS	IC178
5322 209 80072	SN7490AN, TEXAS	IC179
5322 209 80142	SN7442AN, TEXAS	IC180
5322 209 84723	DM8884A NAT.SEMICOND	IC181
5322 209 84976	F34001 PC FAIRCHILD	IC182
5322 209 84183	SN74S74N TEXAS	IC183
5322 209 84528	SN7400N, TEXAS	IC184
5322 209 84227	SN7402N, TEXAS	IC185

TRANSISTORS

Ordering number	Type	Item
5322 130 44418	BF256A	TS101
5322 130 40378	2N918	TS102
5322 130 40542	BFX89	TS103
5322 130 40542	BFX89	TS104
5322 130 44435	2N5770	TS105
5322 130 44418	BF256A	TS106
5322 130 40407	2N2369	TS120

4822 130 40973	BC557B	TS139
5322 130 24035	BT100A-02	TS150
5322 130 40482	BRY39	TS151
4822 130 40855	BC337	TS152
5322 130 44417	BDX35	TS153
5322 130 40482	BRY39	TS154
5322 130 44418	BF256A	TS155
4822 130 40937	BC548B	TS170
5322 130 44247	BSS68	TS180
5322 130 44247	BSS 68	TS181
5322 130 44247	BSS 68	TS182
5322 130 44247	BSS 68	TS183
5322 130 44247	BSS 68	TS184
5322 130 44247	BSS 68	TS185
5322 130 44247	BSS 68	TS186
5322 130 44247	BSS 68	TS187
5322 130 44247	BSS 68	TS188

DIODES

Ordering number	Type	Item
5322 130 30613	BAW62	GR101
5322 130 30613	BAW62	GR102
5322 130 30613	BAW62	GR103
5322 130 30613	BAW62	GR104
5322 130 30613	BAW62	GR105
5322 130 30613	BAW62	GR106
5322 130 30644	BA182	GR110
5322 130 30613	BAW62	GR120
5322 130 30613	BAW62	GR121
5322 130 34047	BZX75-C1V4	GR122
5322 130 30613	BAW62	GR125
5322 130 34382	BZX79-C8V2	GR126
5322 130 30613	BAW 62	GR127
5322 130 34297	BZX79-C10	GR151
5322 130 30594	BAV10	GR152
5322 130 34401	BZX70-C56	GR153
5322 130 30392	BZY88-C3V3	GR154
4822 130 30868	BY210-600	GR155
4822 130 30868	BY210-400	GR156
4822 130 30868	BY210-400	GR157
4822 130 30868	BY210-400	GR158
4822 130 30868	BY210-400	GR159
5322 130 34173	BZX79-C5V6	GR160
5322 130 30613	BAW62	GR161
5322 130 30192	BY126	GR163
5322 130 30414	BY164	GR167
5322 130 30613	BAW62	GR170
5322 130 34049	BZX75-C2V1	GR171
5322 130 30613	BAW62	GR172
5322 130 30613	BAW62	GR173
5322 130 30613	BAW62	GR175
5322 130 34166	BZX79-C51	GR179
5322 130 34189	BAV20	GR180
5322 130 34189	BAV20	GR181
5322 130 34189	BAV20	GR182
5322 130 34189	BAV20	GR183
5322 130 34189	BAV20	GR184
5322 130 34189	BAV20	GR185
5322 130 34189	BAV20	GR186
5322 130 34189	BAV20	GR187
5322 130 34189	BAV20	GR188
5322 130 34335	TIL209 L.E.D.	GR189

INDUCTANCES

Ordering number	Description	Item
5322 158 10289	INDUCTANCE 0,68MH	L101
5322 158 10052	CHOKE	L102
5322 158 10311	INDUCTANCE 1MH	L103
5322 158 10311	INDUCTANCE 1MH	L109
5322 158 10052	CHOKE	L150
4822 526 10097	FXC BEAD	L151
5322 158 10052	CHOKE	L152

MECHANICAL PARTS

Ordering number	Description	Item	Qty.
5322 256 34031	FUSEHOLDER	VL101	2
5322 255 44082	I C HOLDER 14-PINS		1
5322 255 44107	I C HOLDER 16-PINS		1
5322 255 44112	I C HOLDER 18-PINS		5
5322 255 40089	TRANSISTOR HOLDER	TO18-3	11
5322 255 40089	TRANSISTOR HOLDER	TO18-4	2
5322 265 54006	TRANSISTOR HOLDER	TS153	1
5322 265 44064	CONNECTOR 10-PINS	BU103	1
5322 265 44064	CONNECTOR 10-PINS	BU104	1
5322 265 44064	CONNECTOR 10-PINS	BU105	1
5322 255 44107	FEMALE CONNECTOR	BU106	1
5322 267 54102	FEMALE CONNECTOR	BU107	1
5322 276 14117	PUSH BUTTON SWITCH SK104 SK107-SK113	SK103	9
5322 273 74007	ROTARY SWITCH	SK105	1
5322 277 24006	SLIDE SWITCH	SK121	1
5322 263 64007	FEMALE CONNECTOR	SK131 *	1
5322 268 14033	CONNECTOR PIN	SK131 *	4

MISCELLANEOUS

Ordering number	Description	Item	Qty.
5322 146 14079	MAINS TRANSFORMER	T101	1
5322 142 64027	TRANSFORMER DC/DC	T102	1
4822 253 20022	FUSE 1,6 A FAST	VL 150	1
5322 131 94027	DISPLAY ZM1500-9	B101*	1
5322 131 94042	DISPLAY BRO9253	B101**	1
5322 462 34127	GUIDE RAIL		14

FRONT PANEL

Ordering number	Description	Item	Qty.
5322 456 14043	TEXT.PLATE		1
5322 450 64059	WINDOW		1
5322 414 34091	DISPLAY TIME KNOB		1
5322 414 34091	SENSITIVITY KNOB		2
5322 414 34076	FUNCTION KNOB	SK105	1
5322 414 14011	PUSH BUTTON KNOB		9
5322 414 74015	COVER DISPLAY TIME KNOB		1
5322 414 74015	COVER SENSITIVITY KNOBS		2
5322 414 74019	COVER FUNCTION KNOB	SK105	1
5322 267 10004	INPUT SOCKET A ,B	BU1 BU2	2

REAR PANEL

Ordering number	Description	Item	Qty.
5322 290 40011	EXT.BATTERY SOCKETS	BU21 BU22	2
5322 265 30066	MAINS INPUT SOCKET	BU23	1
5322 267 10004	INPUT SOCKET C ;	BU24	1
5322 267 10004	OUTPUT SOCKET 10 MHZ	BU25	1
5322 121 44092	47N,250V,20%	C1	1
5322 277 24017	SLIDE SWITCH.	SK22 **	

CABINET

Ordering number	Description	Qty.
5322 498 54048	HANDLE ARM	2
5322 498 54054	HANDLE PROFILE	1
5322 520 34164	BEARING BUSH	2
5322 414 64053	CAP HANDLE ARM	2
5322 447 84467	TOP COVER	1
5322 447 84466	BOTTOM COVER	1
5322 466 85335	FRONT ORNAMENT	1
5322 459 24054	REAR ORNAMENT	1
5322 462 44181	REAR FOOT	4
5322 462 44179	BOTTOM FOOT	4
4822 462 70497	PLUG BOTTOM FOOT	4

* Only serial number SM1

** Only serial number SM2

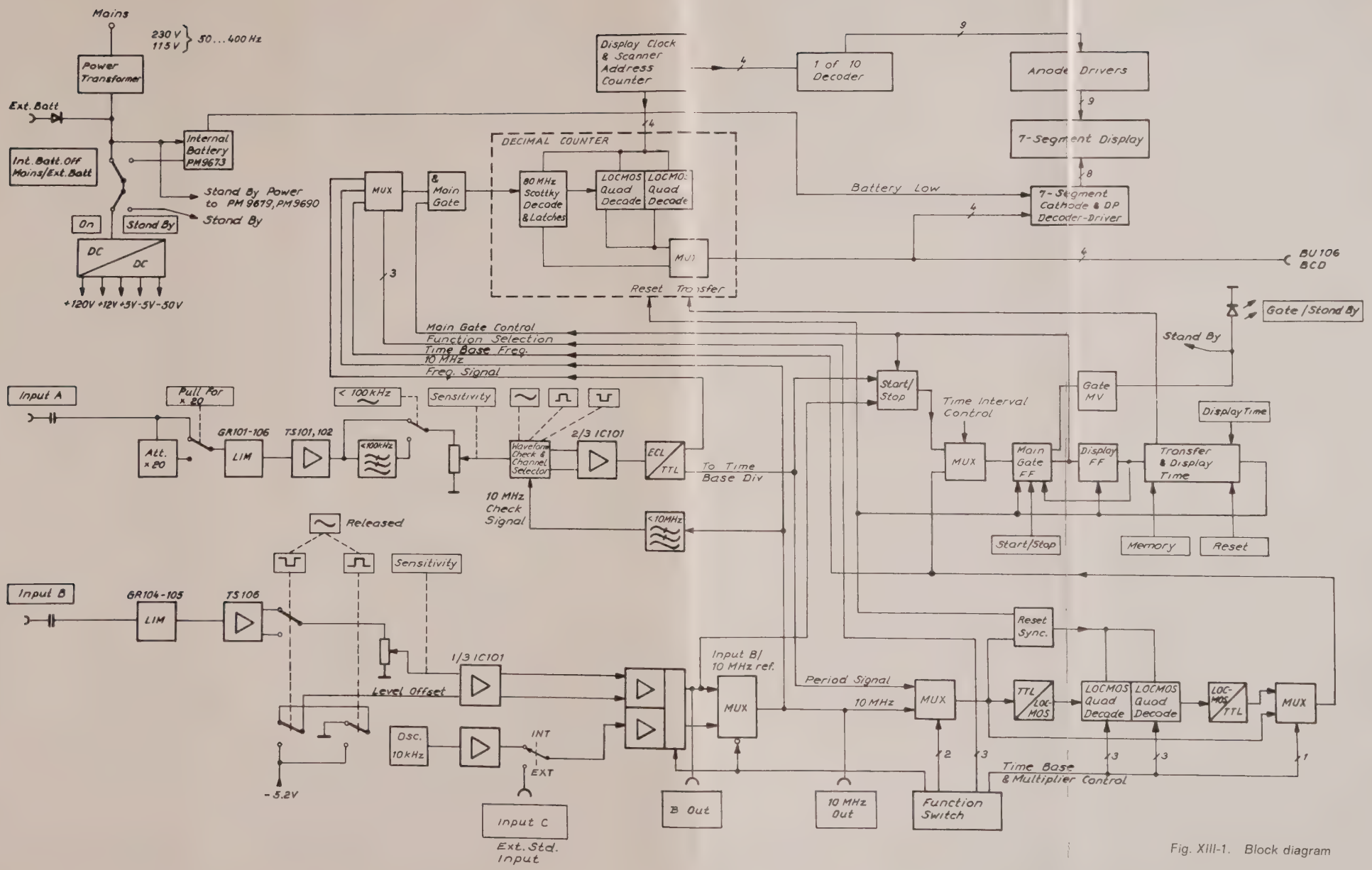


Fig. XIII-1. Block diagram

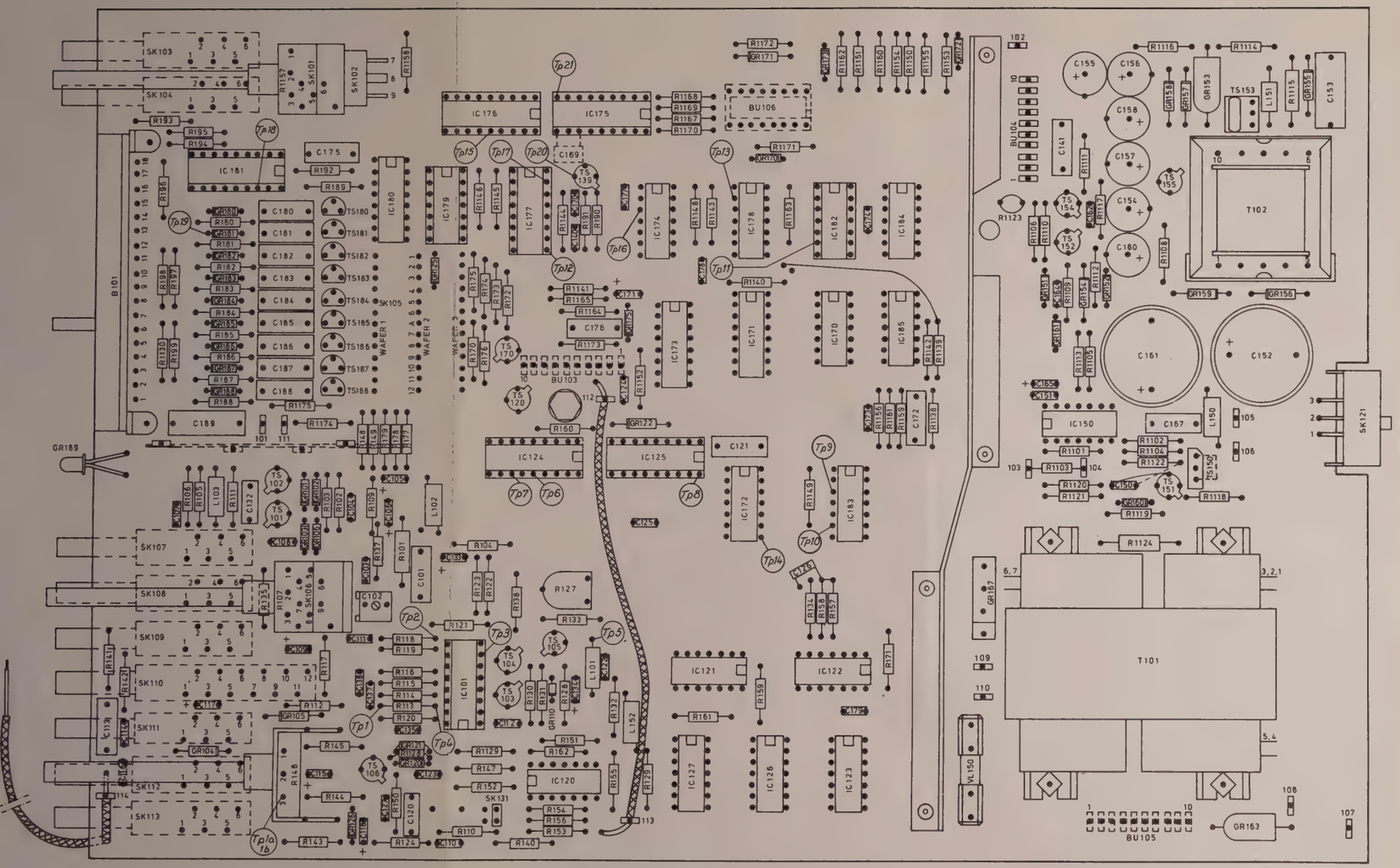
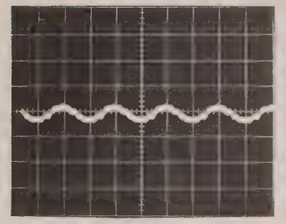


Fig. XIII-2. Component layout

Testpoints 80 MHz input amplifier

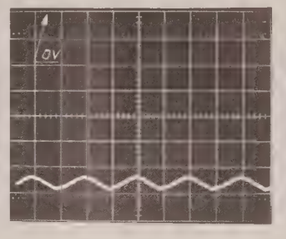
The waveforms are recorded with a 50 MHz oscilloscope PM 3250 including passive 1:10 probe PM 9350 and with the counter set to FREQUENCY 10 Hz, self CHECK mode and min. DISPLAY TIME.
Use figure XIII-2 to identify the location of the test points.

TP 1



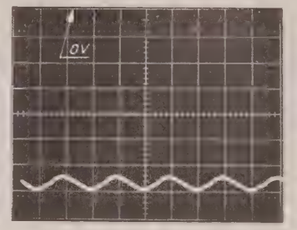
Normal input signal to input amplifier at IC 101:9.
Oscilloscope settings:
2 mV/div. and 50 ns/div. A.C. coupled.
Use 10 MHz OUT from the counter as trigger signal.

TP 2



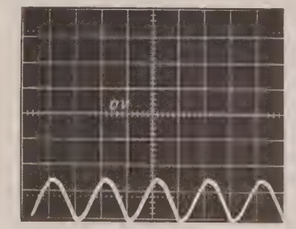
Inverted input signal to input amplifier at IC 101:6.
Oscilloscope settings:
200 mV/div. and 50 ns/div.

TP 3



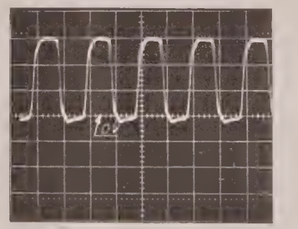
Normal input signal to input amplifier at IC 101:7.
Oscilloscope settings:
200 mV/div. and 50 ns/div.
Use 10 MHz OUT from the counter as trigger signal.

TP 4



Input signal to Schmitt-Trigger at IC 101:3.
Oscilloscope settings:
500 mV/div. and 50 ns/div.

TP 5



TTL output signal at collector of TS 105.
Oscilloscope settings:
1 V/div. and 50 ns/div.

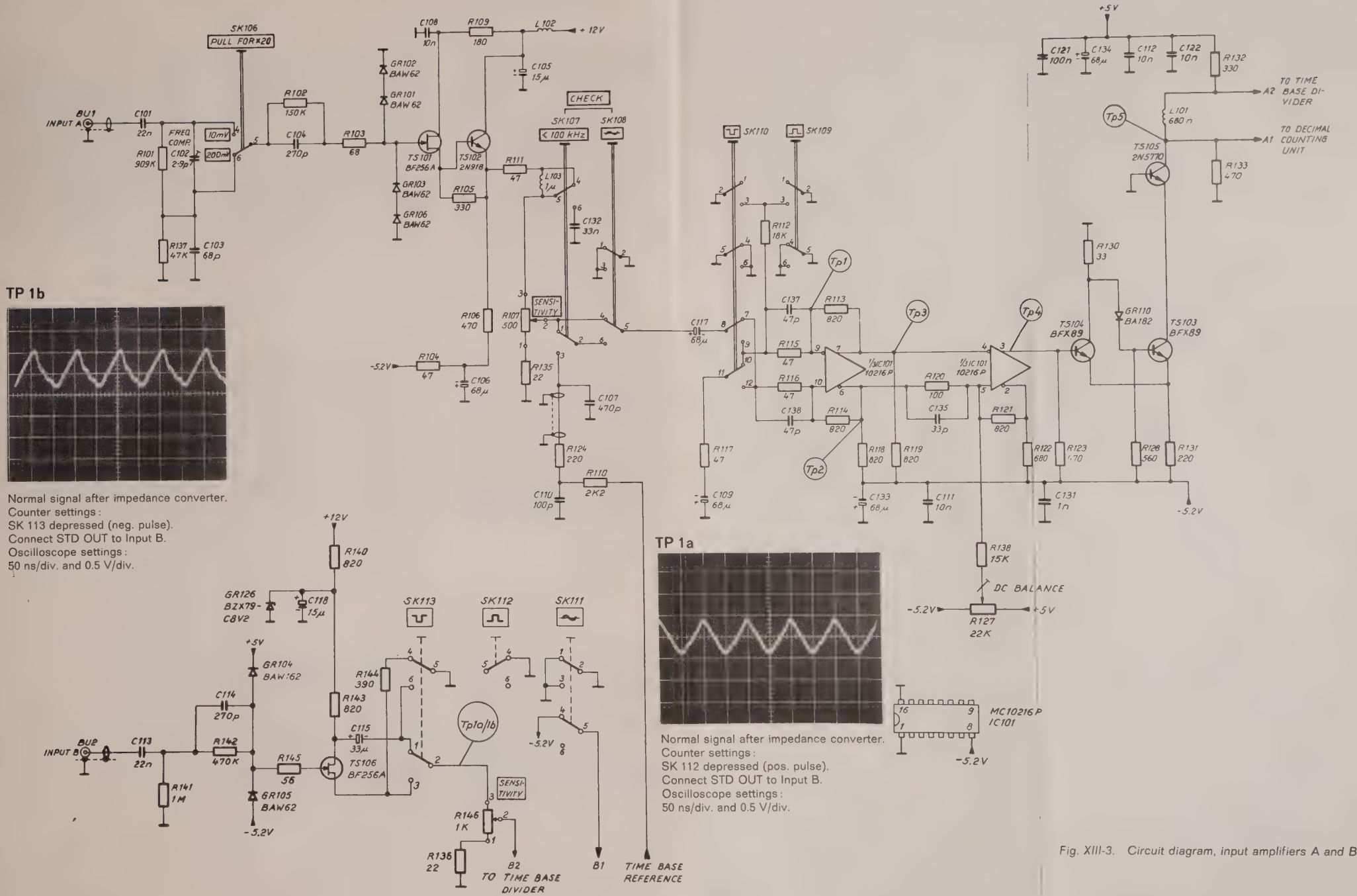
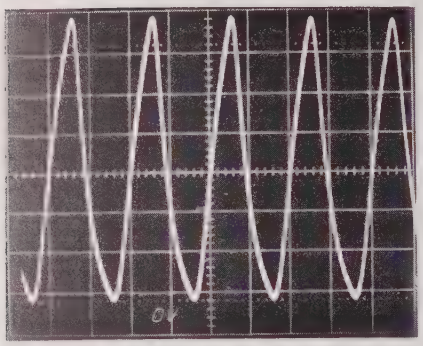


Fig. XIII-3. Circuit diagram, input amplifiers A and B

Testpoints time base divider

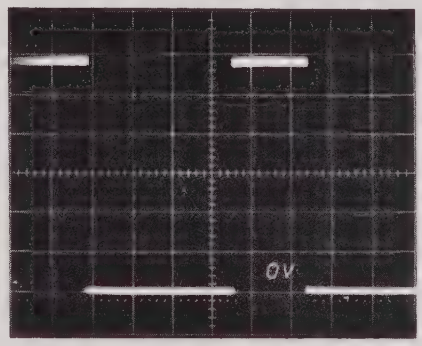
The waveforms are recorded with a 50 MHz oscilloscope PM 3250 including passive 1:10 probe PM 9350 and with the counter set to FREQUENCY 10 Hz, self CHECK mode and min. DISPLAY TIME.
Use figure XIII-2 to identify the location of the test points.

TP 6



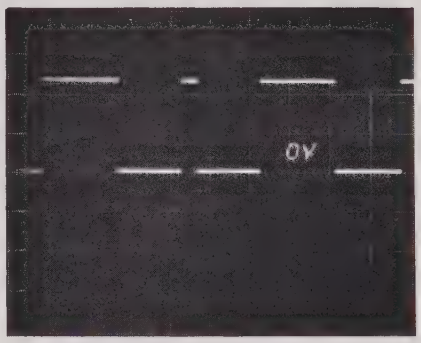
Time base divider input signal at IC 124:14.
Oscilloscope settings:
1 V/div. and 50 ns/div.

TP 7



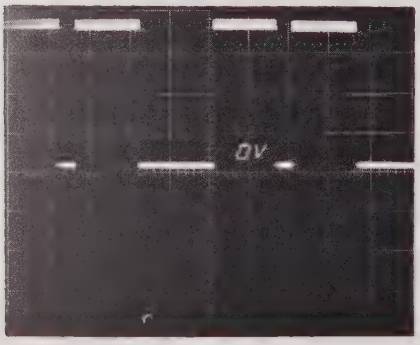
Time base preset signal at IC 124:12.
Oscilloscope settings:
2 V/div. and 50 ms/div.

TP 8



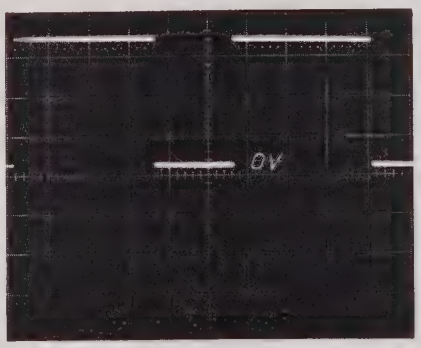
Time base signal at IC 125:18.
Oscilloscope settings:
5 V/div. and 50 ms/div.

TP 9



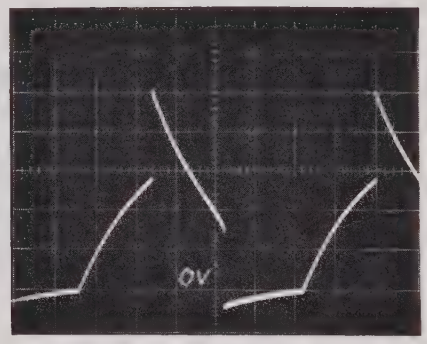
Time base signal at IC 183:3.
Oscilloscope settings:
1 V/div. and 50 ms/div.

TP 10



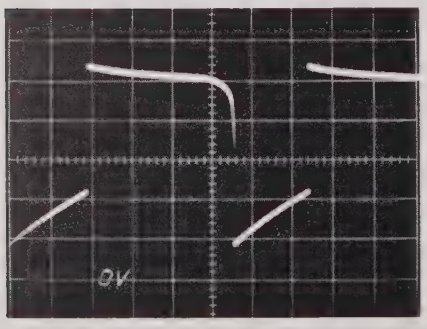
Main gate signal at IC 183:6.
Oscilloscope settings:
1 V/div. and 50 ms/div.

TP 11



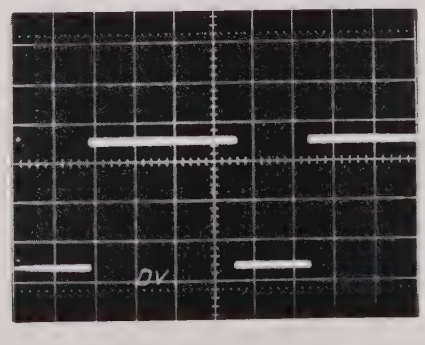
Display time triggering signal at IC 182:6.
Oscilloscope settings:
1 V/div and 50 ms/div.

TP 12

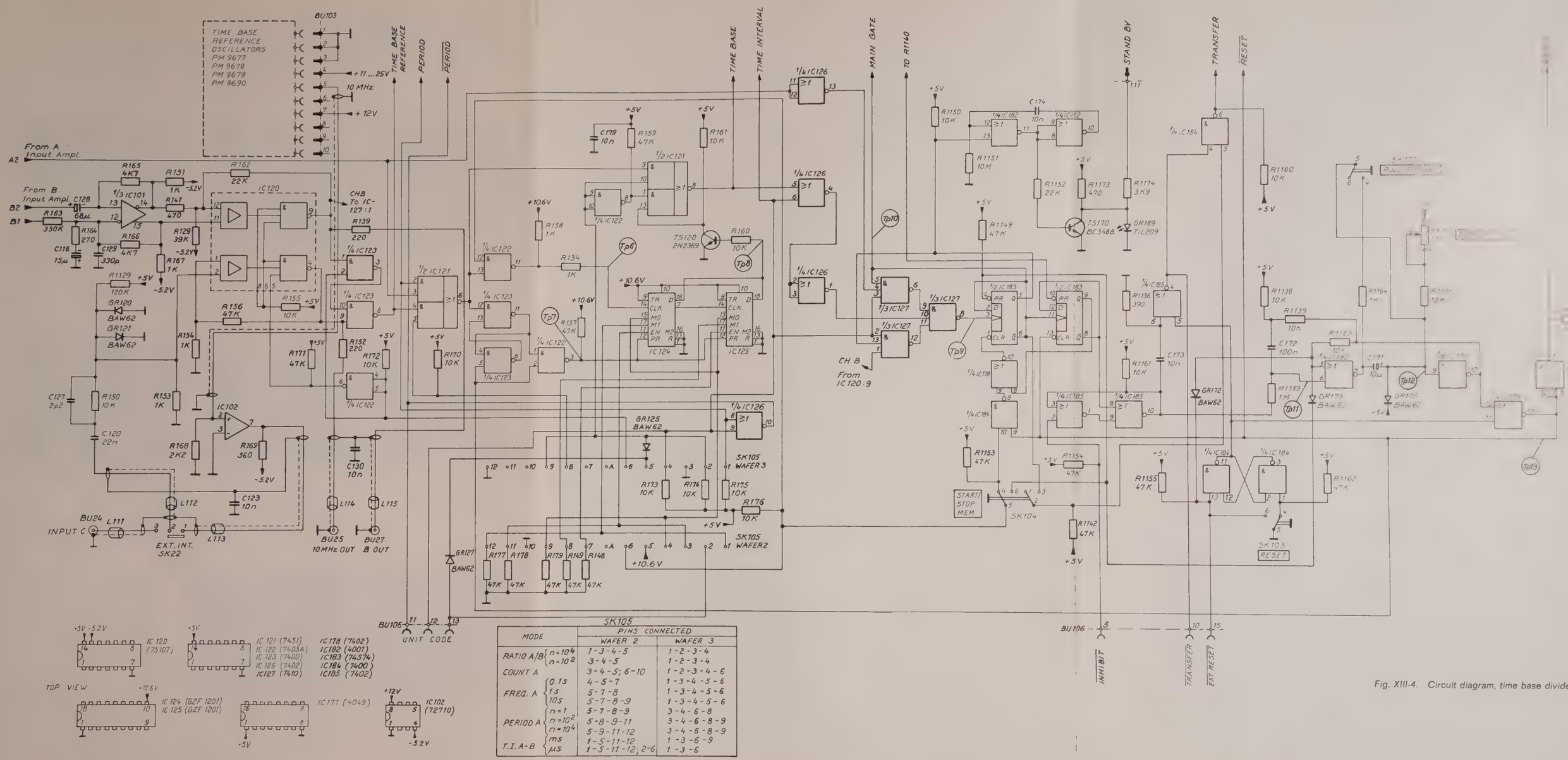


Display time sweep signal at IC 177:9.
Oscilloscope settings:
1 V/div. and 50 ms/div.

TP 13



Reset signal at IC 178:2.
Oscilloscope settings:
1 V/div. and 50 ms/div.



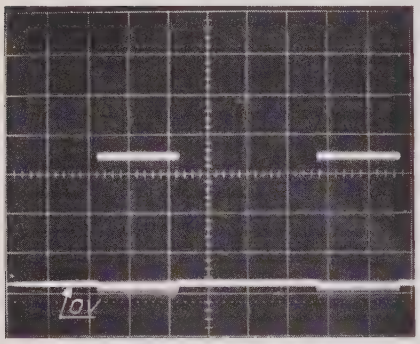
SK105			
MODE		PINS CONNECTED	
		WAFER 2	WAFER 3
RATIO A/B	n=10⁴	1-3-4-5	1-2-3-4
	n=10²	3-4-5	1-2-3-4
COUNT A		3-4-5; 6-10	1-2-3-4-6
FREQ. A	0.1S	4-5-7	1-3-4-5-6
	1S	5-7-8	1-3-4-5-6
	10S	5-7-8-9	1-3-4-5-6
PERIOD A	n=1	5-7-8-9	3-4-6-8
	n=10²	5-8-9-11	3-4-6-8-9
	n=10⁴	5-9-11-12	3-4-6-8-9
T.I.A-B	ms	1-5-11-12	1-3-6-9
	µs	1-5-11-12; 2-6	1-3-6

Fig. XIII-4. Circuit diagram, time base divider

Testpoints decimal counting unit and display

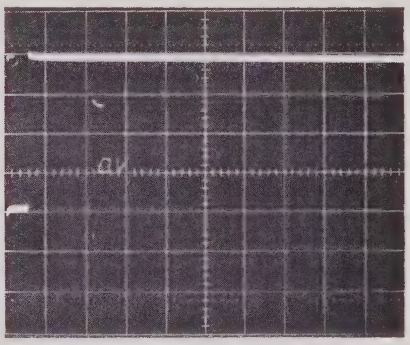
The waveforms are recorded with a 50 MHz oscilloscope PM 3250 including passive 1:10 probe PM 9350 and with the counter set to FREQUENCY 10 Hz, self CHECK mode and min. DISPLAY TIME.
Use figure XIII-2 to identify the location of the test points.

TP 14



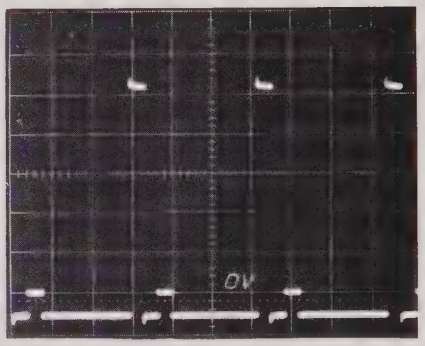
Gated input signal at IC 172:8.
Oscilloscope settings:
1 V/div. and 50 ms/div.

TP 15



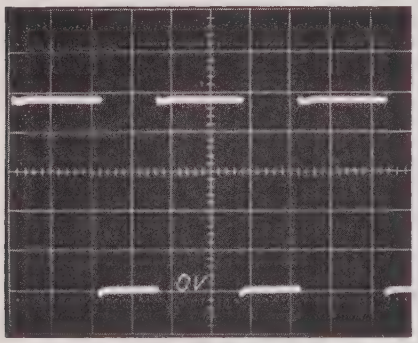
Carry signal $1:10^5$ at IC 176:14.
Oscilloscope settings:
2 V/div. and 2 μs/div.

TP 16



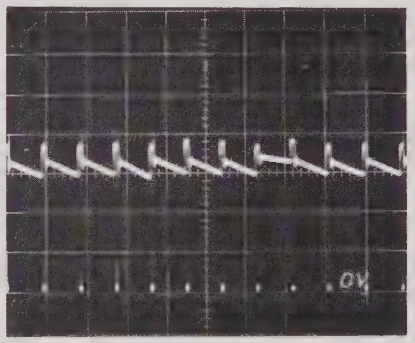
Data A signal at IC 174:3 when last digit is zero.
Oscilloscope settings:
1 V/div. and 0.5 μs/div.

TP 17



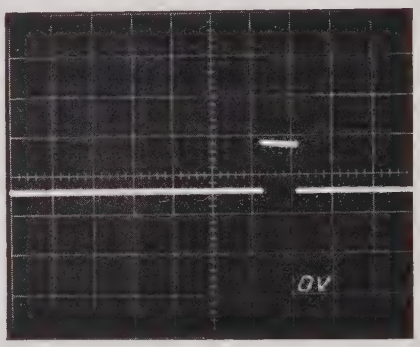
Display clock signal at IC 177:15.
Oscilloscope settings:
1 V/div. and 50 μs/div.

TP 18



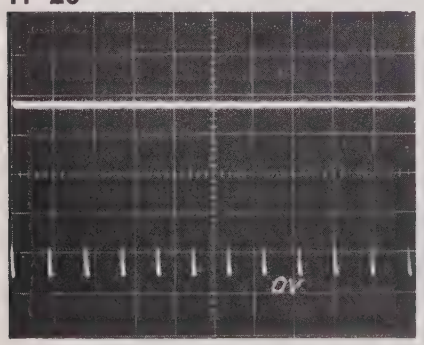
Display cathode signal at IC 181:16 when last digit is zero.
Oscilloscope settings:
20 V/div. and 0.2 ms/div.
Use signal at IC 179:11 as trigger signal.

TP 19



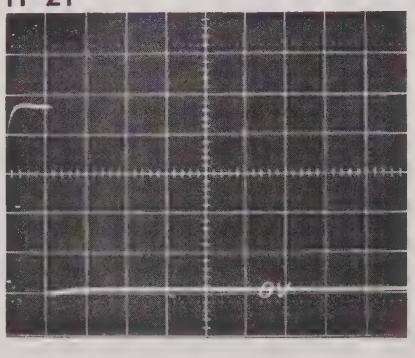
Display anode signal at cathode of GR 181.
Oscilloscope settings:
50 V/div. and 0.2 ms/div.
Use signal at IC 179:11 as trigger signal.

TP 20



Display blanking signal at collector of TS 139.
Oscilloscope settings:
1 V/div. and 0.2 ms/div.

TP 21



Transfer signal at IC 175:9.
Oscilloscope settings:
1 V/div. and 5 μs/div.

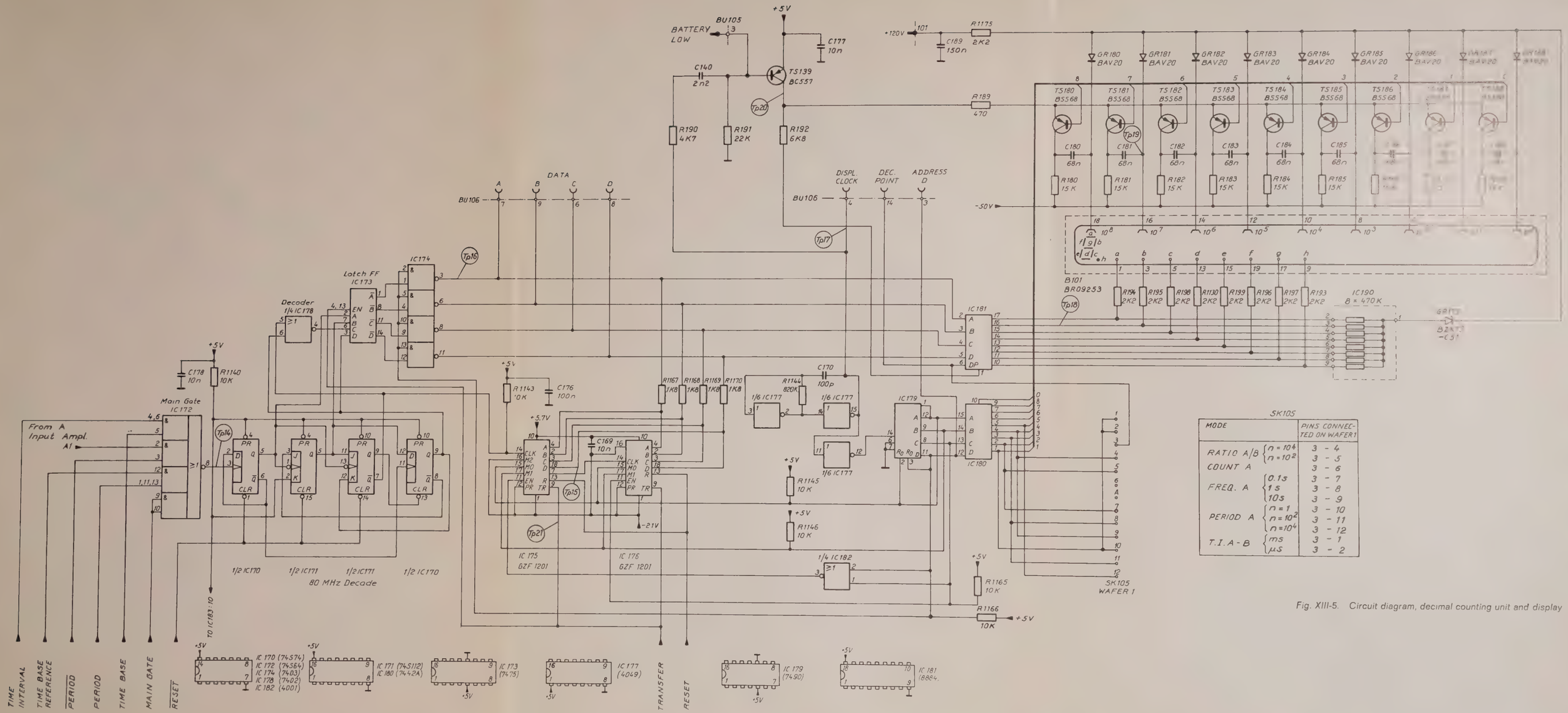


Fig. XIII-5. Circuit diagram, decimal counting unit and display

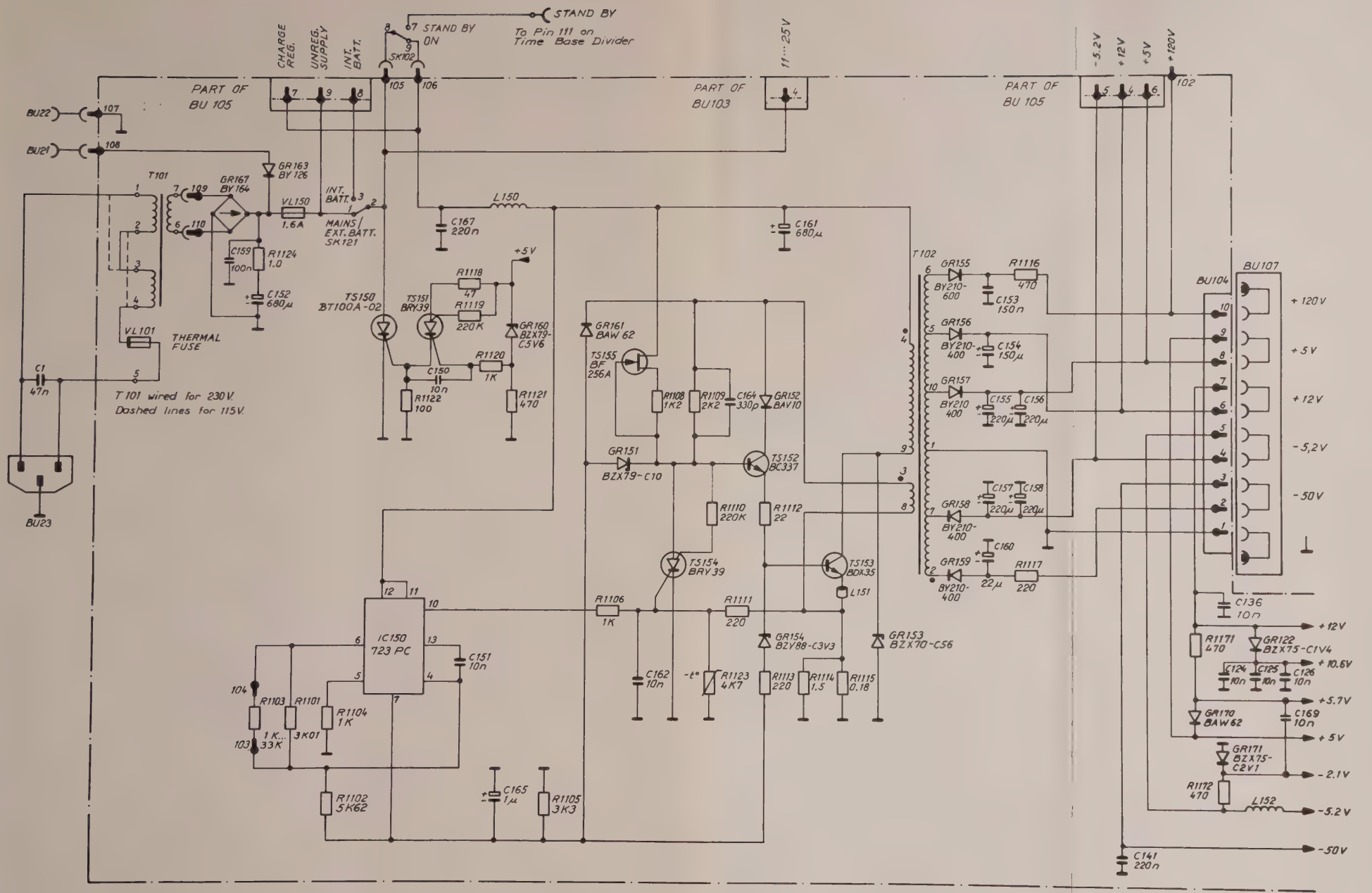


Figure XIII-6. Circuit diagram, power supply

QUALITY REPORTING

CODING SYSTEM FOR FAILURE DESCRIPTION

The following information is meant for Philips service workshops only and serves as a guide for exact reporting of service repairs and maintenance routines on the workshop charts.
For full details reference is made to Information G1 (Introduction) and Information Cd 689 (Specific information for Test and Measuring Instruments).

LOCATION

□□□

Unit number
e.g. 000A or 0001 (for unit A or 1; **not 00UA or 00U1)**

or: Type number of an accessory (only if delivered with the equipment)
e.g. 9051 or 9532 (for PM 9051 or PM 9532)

or: Unknown/Not applicable
0000

COMPONENT/SEQUENCE NUMBER

□□□□□

Enter the identification **as used in the circuit diagram**, e.g.:

GR1003	Diode GR1003
TS0023	Transistor TS23
IC0101	Integrated circuit IC101
R0....	Resistor, potentiometer
C0....	Capacitor, variable capacitor
B0....	Tube, valve
LA....	Lamp
VL....	Fuse
SK....	Switch
BU....	Connector, socket, terminal
T0....	Transformer
L0....	Coil
X0....	Crystal
CB....	Circuit block
RE....	Relay
BA....	Battery
TR....	Chopper

CATEGORY

□

0 Unknown, not applicable (fault not present, intermittent or disappeared)
1 Software error
2 Readjustment
3 Electrical repair (wiring, solder joint, etc.)
4 Mechanical repair (polishing, filing, remachining, etc.)
5 Replacement
6 Cleaning and/or lubrication
7 Operator error
8 Missing items (on pre-sale test)
9 Environmental requirements are not met

Parts not identified in the circuit diagram:

990000	Unknown/Not applicable
990001	Cabinet or rack (text plate, emblem, grip, rail, graticule, etc.)
990002	Knob (incl. dial knob, cap, etc.)
990003	Probe (only if attached to instrument)
990004	Leads and associated plugs
990005	Holder (valve, transistor, fuse, board, etc.)
990006	Complete unit (p.w. board, h.t. unit, etc.)
990007	Accessory (only those without type number)
990008	Documentation (manual, supplement, etc.)
990009	Foreign object
990099	Miscellaneous

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Eire: Philips Electrical (Ireland) Ltd., Newstead, Clonskeagh, Dublin 14; tel. 976611

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Test and Measuring Instruments Dept.
Eindhoven - The Netherlands

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